The AMSAT® Journal

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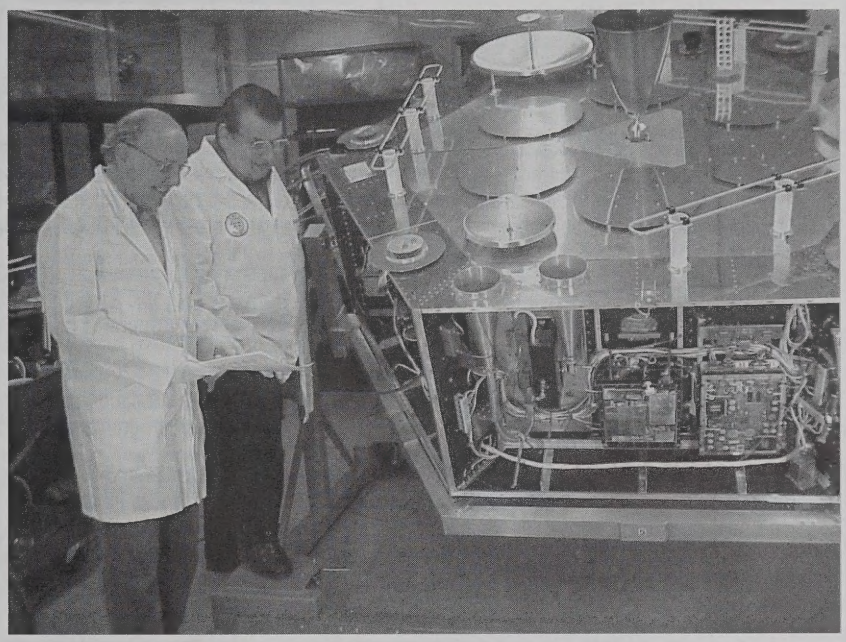

AMSAT-DL President and Phase 3D Project Leader Karl Meinzer, DJ4ZC (l) and AMSAT-DL Vice President Werner Haas, DJ5KQ (r) with the Phase 3D satellite during March 1999 testing at the Phase 3D Integration Laboratory, Orlando, Florida. (See the related article on page 26)

Phase 3D Launch Status Update

Keith Baker, KB1SF, AMSAT-NA President, released a letter dated May 14, 1999 from Dr. Karl Meinzer, DJ4ZC, AMSAT-DL President and Phase 3D Project Leader. The letter, addressed to Dayton Hamvention attendees, sheds new light on the current launch status of the Phase 3D International Satellite. Dr. Meinzer wrote:

Greetings! As you well know, I very much have been looking forward to joining you for the 1999 Dayton Hamvention. Unfortunately, recent developments regarding our launch situation for Phase 3D have now made it necessary that I remain here in Germany during the Hamvention event.

[continued on page 4]

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Apogee View

Wake up Call!

Keith Baker, KB1SF

No doubt, by now you have all heard about the Russian's plan to launch yet another mini-Sputnik from the *Mir* space station that would have created a new and quite controversial chapter in Amateur Radio history. The previous two mini-Sputniks were quite popular with Hams and others around the world. This one would have also been quite popular among Hams, but for some quite different reasons that weren't necessarily positive.

Without getting into all the details, suffice it to say that our compatriots in AMSAT-France, working under a monetary contract, helped a Russian team build the electronics for yet another mini-Sputnik. Like the last one, it, too, would have been able to play back pre-programmed voice messages from orbit. However, very late into the project AMSAT-France officials learned that a separate contract had also been completed between Russian officials and the SWATCH watch company of Switzerland to record and then re-broadcast (in FM using our Amateur 2 meter band!) a number of pre-recorded *endorsements* of an Internet *beat* time advertising campaign being promoted by the SWATCH company from orbit!

Needless to say, once word about this proposal was passed along to the world's Hams, an uproar soon followed. AMSAT-France (along with a majority of Hams) contended this would amount to nothing short of using Amateur Radio frequencies for commercial purposes, something that is clearly prohibited in the International Telecommunications Rules that underlie our service. SWATCH, for their part, argued that, as the broadcasts would not be mentioning their company by name in the messages, what they wanted to do was perfectly legal under the International rules. Maybe so, but their approach also came up against another long-held tenets of Amateur Radio that prohibits Amateurs from using our frequencies to broadcast messages intended for receipt by the general public.

Fortunately, at the last minute, and after some strong lobbying and intervention efforts by the International Amateur Radio Union (IARU) and a number of other national Amateur Radio societies [most notably our American Radio Relay League (ARRL) and the Radio Amateurs of Canada (RAC)], SWATCH officials *saw the light* and gracefully dropped their plans to activate the satellite after launch. Believing that a direct public and frontal attack was not in our best interests and would not be effective, your AMSAT-NA officials were also working very hard (but very quietly and behind the scenes) in direct support of AMSAT-F, DARC, ARRL, RAC and IARU appeals.

Now, some of you will argue that we lost a superb opportunity here to support a project that would have brought the excitement of Amateur Radio from space directly into the homes of potential new Hams. We understand SWATCH was also planning to carry the voice messages in real audio via their web site. There is no doubt that a *SWATCHsat* would have sparked such interest and could also have been a great advertisement for Amateur Radio.

However, regardless of which side of this particular effort you chose to support, the incident should have been a wake up call to all of us regarding just how vulnerable our frequency allocations are to encroachment from well-heeled commercial or other interests who wish to use our frequencies for their own purposes. In particular, it should now be quite evident that, because of the location of our satellites...in orbit.....local or regional issues in one part of the world (in this case it was ITU Region 1) regarding use of otherwise terrestrial allocations in the VHF and UHF bands (and above) soon become global issues and have a DIRECT impact on your and my operating here in North America.

Such encroachment is not new. AO-27 is frequently plagued by interference from unlicensed communications over Europe and Central America. There have also been planned wholesale giveaways of some Amateur Radio VHF and UHF frequencies to commercial interests in such diverse places as Guatemala and Hong Kong. Unfortunately, these otherwise local or regional frequency allocation issues soon take on an international flavor for those of us who enjoy operating the Amateur Radio satellites.

And, if you still don't believe this, think for just a moment about the havoc we'll have on Phase 3D when a Guatemala or a Hong Kong decides to unilaterally allow a busy terrestrial commercial communications service to freely operate in the middle of Phase 3D's 70cm uplink passband! And, with the increasing pressures on frequencies now allocated to the other worldwide satellite services, our bands as a whole (and our Amateur Satellite Service bands in particular) are becoming ever more *juicy* targets for well-heeled efforts such as that recently proposed by SWATCH. Remember the Little LEOs? I believe the SWATCHsat was simply Chapter 2. Next time, the CEO of another commercial company planning a similar venture may not be so understanding of our uniqueness.

So "what can I do to stop this" you ask? First and foremost, as our AMSAT-NA Treasurer Art Feller, W4ART, would say, "Get on the air and make some noise." That is, get on the birds. Make some contacts. Use what we

Some AMSAT-NA charter members (left to right) Perry Klein, W3PK (LM-1); Lynne Puglise, XYL-K9CQ; Dick Mostow, W3YAV (00004); Jim Puglise, K9CQ (00003); and Bill Tynan, W3XO (LM-10).

already have in orbit. Operate, Operate, Operate. Frequent and continued use of our frequency allocations and our satellites now in orbit...ALL of them.....is, by far, our best deterrent to interlopers. Those agencies looking to park their busy commercial activities or satellite downlinks in our midst can (and often do) listen to and log the activity on our bands. A quiet Amateur Radio satellite band day after day (after day) becomes irrefutable proof that we aren't using our allocations. Any way you cut it, non-use is an open invitation for encroachment.

And when the next plan like SWATCHsat comes along...and it will....please use descretion in any public statements you may wish to make either for or against the proposal at hand. I was absolutely appalled at some of the venom and personal attacks that were lodged against SWATCH and its officers over this issue. Unfortunately, the individual behavior of a few of us in Amateur Radio made ALL of us come across publicly in this case much like a group of spoiled children. In the end, I can tell you that the venom coming from some within our ranks simply hardened SWATCH's resolve to press ahead with their plans. On the other hand, it was quiet, behind-the-scenes diplomacy as well as the sound, well-organized, non-emotional, and well-supported logic in the majority of our public appeals that ultimately changed the SWATCH people's minds.

Bottom line: The SWATCHsat incident makes it absolutely clear that we can no longer hide behind International or host country rules and regulations to protect our satellite frequency allocations. That is, simply telling a well-heeled commercial or other interest that "you can't do that because the (ITU, FCC, or XXX (pick one) rules say you can't" is no longer an effective deterrent. Rather, WE are now going to have to redouble our efforts to deter such encroachments by showing others we are being good stewards with the valuable resources we now control. That is, we need to demonstrate by both our words AND our actions that we are WORTHY of continued, unhampered access to the literally trillions of dollars worth of frequency spectrum we now so often simply take for granted.

The rest of the word IS watching and listening to us! Next time we may not be so lucky. ■

[Phase 3D continued from page 1] As many of you know, AMSAT-DL is the principal agency responsible for securing a safe and affordable launch for Phase 3D. Since this project began, we had secured such a launch opportunity on one of the Ariane-5 test flights, which were conducted under the control of the European Space Agency (ESA).

Unfortunately, this launch agreement for Phase 3D with ESA did not work out, essentially due to the failure of the first Ariane-5 flight and the resulting aftermath. Since ESA is not conducting such flights anymore, my team and I have been working very hard over the past year or so to find a replacement launch. We have been patiently negotiating with a number of different launch agencies and it looks now that this work is starting to pay off as it is beginning to yield results.

I am pleased to report to you that we are currently in the final phase of working out the details of an agreement for the launch of Phase 3D with one of these launch agencies. At this point, I am very optimistic and I believe this launch agency is genuinely working very hard toward providing us a launch for Phase 3D. I am also very hopeful that in the following weeks a launch contract can be closed which contains conditions we can meet. The agency has now identified some launches over the next year or so which have enough performance margin to allow the inclusion of Phase 3D in addition to the main payload.

The launcher business these days has become extremely competitive and it is has become nearly impossible for launch agencies to fix their launch-plan for more than half a year ahead. Thus, even after our contract is closed, we will remain a stand-by passenger. However, judging from the presently known plans, they ***could*** - *and I emphasize the word* ***could*** - lead to a launch of our satellite as early as of October 1999. Of course, this all assumes that the remaining open details of our interface with their launch vehicle can be successfully worked out and that we do not run into some last-minute problems with our contract.

Needless to say, I am delighted with this turn of events. My only remaining wish is that I could be there in Dayton to share them with you in person. Please accept my sincere best wishes for a productive AMSAT Forum at Hamvention and my thanks for your continued patience and strong support of our efforts.

73,

Dr. Karl Meinzer, DJ4ZC, AMSAT-DL President and Phase 3-D Project Leader

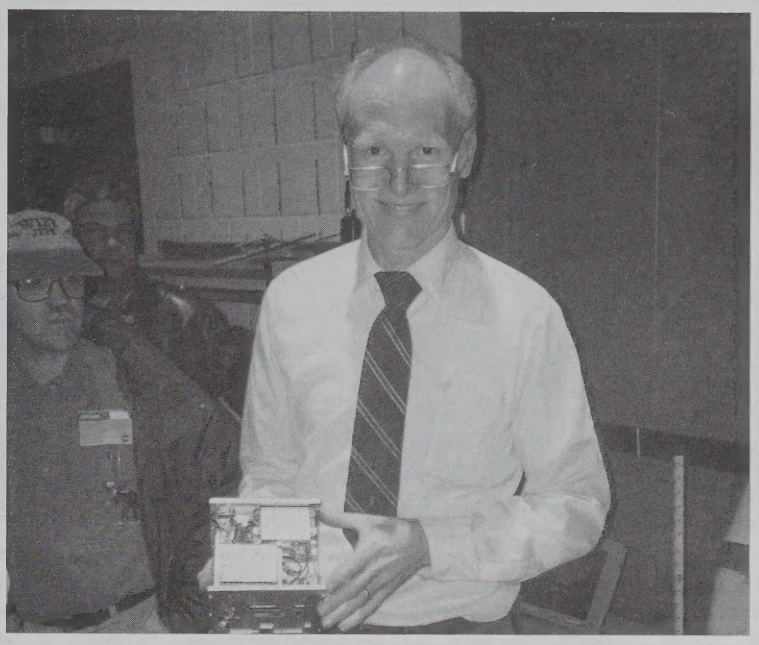
Reflections on Thirty Years of AMSAT:
An Interview with Four of Its Founders and Leaders

The Radio Amateur Satellite Corporation (AMSAT-NA) was incorporated on March 3, 1969 as a non-profit organization in the District of Columbia. This past March 13th, over 100 AMSAT members commemorated this event by attending a celebration held at the NASA Goddard Space Center. In conjunction with accomplishing this milestone, the following members were interviewed to reflect on AMSAT's accomplishments, present situation, and future direction:

- Dick Daniels, W4PUJ: Member, Board of Director,
- Perry Klein, W3PK: Charter Member, Past President, and Founding President Emeritus
- Bill Tynan, W3XO: Charter Member, Past President, and Chairman of the Board
- Ray Soifer, W2RS: AMSAT Vice President for International Affairs, Former Board of Director (1972-74) and AMSAT member since April 1969.

Today, AMSAT-worldwide is comprised of over 10,000 members with a fleet of digital and analog satellites in operation. In addition, Amateur Radio is active on the Space Shuttle, Mir Space Station, and soon-to-be operational International Space Station. When organizing AMSAT in 1969, did your vision include the magnitude and diversity of these accomplishments?

W4PUJ: I missed all of the fun in the early days of setting up AMSAT. I came on board in late-1970, if I recall correctly, when the basic organizational structure was already in place. While my primary interest at that time was hardware building, beginning with the AMSAT-OSCAR 6 development, I did regularly participate in BOD meetings as an observer, and so witnessed much of the planning for this and follow-on projects, as well as the endless discussions on organizational issues and planning for extensive educational programs. I was continually amazed at how successful we were in garnering support for the development of a series of increasingly sophisticated communications satellites and attracting the support from key *fellow travelers* in NASA and the aerospace industry. On the other hand, remembering some of the discussions of ambitious educational programs, including the bringing in of third-world people for formal training, I would have to rate our achievements here lower. The most notable exception is the very successful SAREX/*Mir* program involving schools around the world. One area of success where I suspect we were all surprised, was the speed with which the membership grew to thousands, worldwide, and the impetus given to formation of AMSAT organizations in other countries.



Bob Bruninga, WB4APR brought along his NATSweb satellite prototype to share with anniversary participants. See the March/April 1999 issue of *The AMSAT Journal* for additional details on the NATSweb satellite. (photo by Perry Klein, W3PK)

W3PK: I certainly didn't. In high-tech areas like this, who could have predicted what would be possible. In those days, we only had Apples, Ataris and Commodore C64's and were limited in what was possible. We were delighted when the Russians launched their own RS amateur satellites, complete with Morse code telemetry. And who could have foreseen the transition to digital communications. The use of amateur equipment on the Shuttle and *Mir* was another innovation we hadn't thought of. Now we are seeing five or six OSCAR launches a year, with satellite payloads being developed all over the world. It's certainly very exciting to see this happen!

W2RS: I don't think anyone anticipated today's digital satellites because packet radio hadn't been invented yet. I don't recall anyone in 1969 talking about manned space missions either. AMSAT's

Shuttle Mission Specialist Ron Parise, WA4SIR (l) and AMSAT Vice President of Human Spaceflight, Frank Bauer, KA3HDO (r) at the tour of the Goddard Amateur Radio Club station. (photo by Perry Klein, W3PK)

Discussing business while waiting for an AO-27 pass? (From left to right) Barry Baines, WD4ASW; Jan King, W3GEY; Martha Saragovitz; Keith Baker, KB1SF; Frank Bauer, KA3HDO; and Bill Tynan, W3XO. (Photo by Perry Klein, W3PK)

main objectives, as I remember them, were to put more analog transponders into orbit to succeed OSCARs III and IV, and otherwise to promote the use of the VHF and UHF bands. I believe we've succeeded.

What do you consider some of AMSAT's key technical accomplishments?

W4PUJ: Most notable was the degree to which providing communications capabilities at higher frequencies, and with a wider range of modulation techniques encouraged many in the amateur radio community to upgrade their technical skills. The development of increasingly sophisticated tracking and station control computer programs is clearly another area where AMSAT took the lead is another. While AMSAT can't take too much credit for initiating the boom of packet radio, we probably could claim that, through the *pacsats* we have kept the technique alive and well in satellite operations while much of the rest of the activity has fallen to the Internet.

W3PK: I would say the development of sophisticated low-cost, long-life satellites that can be used operationally on a regular basis. The search-and-rescue and store-and-forward low-orbiting satellite applications were demonstrated by the OSCAR satellites and now are in commercial use in worldwide systems.

W3XO: Being able to build and launch successful satellites on a relative shoestring.

W2RS: Not being primarily a technical person, I will defer to others on the specifics, but many of today's key space communications technologies were first utilized by AMSAT. I had a lot of fun, for example, participating (with Ben Stevenson, W2BXA) in the world's first two-way communication (QSO) in any radio service by satellite-to-satellite relay, using AO-7 and AO-6, in 1975.

What do you consider a member's role and responsibility in AMSAT?

W4PUJ: First and foremost, the members have the responsibility to support their organization, through financial support, technical support where the capability exists, and making others aware of what the Amateur Radio satellite programs have achieved. One of my strongest disappointments is our failure to gain greater recognition of our accomplishments outside, and even within, the Amateur Radio community. Part of the problem is that, as an organization of technologists, few seem to have the skills and obsessive-compulsive drive to devote themselves to advertising the product. It is not in our culture.

W3PK: I think it's a member's responsibility to introduce and involve others, especially the younger generation, to amateur satellite communications. If AMSAT is to be successful in the long term, we need to bring in *new blood.*

W3XO: To contribute to the continued success of the organization either financially or through volunteering to perform some kind of service.

W2RS: As with other Amateur Radio organizations, AMSAT is no more and no less than what its volunteers make it. I would like to see all members contributing their talents (whatever they happen to be) to the cause, as well as contributing financially to the extent they are able to do so.

In 1969, when AMSAT was founded, most members were satellite builders. How can we, or for that matter should we, encourage or mentor members to promote satellite construction?

W4PUJ: AMSAT has always been an organization made up of a large number of individuals who take a high degree of satisfaction in being a part of an activity that represents the application of sophisticated technology to satisfying the urge of most amateurs to demonstrate their skills in communication, operating near the state of the art. Of the total membership, the number of individuals who have the skills, drive, and willingness to make the personal sacrifices necessary to create these satellites has been a relatively small percentage. I do not expect this to change in the future. What is important, is that we must support a large enough range of development activities, short and long term, to attract as many individuals as possible to the technical teams. As others have said, our future may lie more in interaction with the university community where an increasing number of small satellite projects are being initiated.

W3PK: By carefully documenting how to build satellites and satellite subsystems, and by continuing to involve universities and student groups. There are a lot of research projects, theses and dissertations that can and have come out of this work.

W3XO: Not all of us were. Some were managers, writers and/or administrators, etc. AMSAT found ways for all of them to contribute

W2RS: For a variety of reasons, most satellite construction projects today are based at universities. I would hope, though, that technically qualified groups of amateurs will still find ways of making their presence felt.

Currently a team has been formed to chart AMSAT's strategy for the next five years. What advice or vision do you have for this team?

W4PUJ: Unfortunately, we are not as unique as we once were. While we can rightfully claim to have been the foremost pioneers in the field of small satellites, we are being overrun by the commercial interests. Where we continue to be unique is our capability to challenge highly capable individuals to volunteer their skills and energies to demonstrate their abilities to do as well, if not better, than *the big guys*. We have been able to move faster, exploit new technologies and take greater technical risks that those who are forced to operate within the constraints of the world of commerce. As importantly, we have been able to impart to individuals a feeling of accomplishment that they find lacking in their professional worlds. While this is more of a challenge today than it was when AMSAT was founded, I believe we can still attract and retain these individuals if we are able to provide a large enough platter of goodies for them to feast on.

W3XO: In my opinion, we must continue as active spacecraft builders. If we become only a

membership organization, we will eventually cease to exist.

W2RS: I don't envy the strategic planning group's task. Some years ago, I was in charge of corporate long-range planning for a large multinational bank. The main thing I took away from that experience is that the future is really unpredictable, especially when technology is involved. Like the bank, we must try to keep our options open, to recognize opportunities and risks when they appear, and to strike while the iron is hot. The other thing which we must never forget is that AMSAT exists primarily to serve its members: individual radio amateurs who wish to enjoy their hobby through space communications. They are AMSAT's *stockholders* — it is they who elect the board, which in turn appoints the officers and committee members.

What makes AMSAT unique and holds it together? What can we do to preserve and promote our uniqueness?

W2RS: What makes AMSAT unique is what makes amateur radio unique: in the words of the ITU Radio Regulations, it is a radio service made up of duly authorized persons interested in radio technique solely with a personal aim and without pecuniary interest. If we continue to bear that definition in mind as we move forward, preserving the uniqueness of our heritage will take care of itself.

W3PK: With the wide availability of the Internet and of cellular and personal communications, some say that amateur radio is becoming less popular. So we need to encourage more innovation and experimentation in order to assure continued interest.

W3XO: To continue to build spacecraft and, even more difficult; to find affordable launches for them.

W4PUJ: The Internet is our greatest threat. A close second is the growth of small satellite projects in the universities that provide very attractive alternatives to young people who would have been drawn to AMSAT sponsored activities in the past. A longer term threat, requiring strong and continuing action on our part, is defense of the spectrum allocated to the Amateur Satellite Service from the determined efforts of commercial and other interests as they seek relief from the pressures of rapidly expanding needs within a fixed amount of spectrum.

What are current challenges for the Amateur Radio satellite community? What do you the think effect of Phase 3D and future amateur satellites will be during the next 30 years?

W4PUJ: Phase 3D is the most magnificent technical challenge ever undertaken by the international AMSAT organizations. When it is in orbit, the spacecraft will provide communications capabilities undreamed of when AMSAT was founded. At the same time, the nine-year development cycle, and major funding requirements necessary to bring this capability into being operating through a widely geographically dispersed, largely volunteer organization, has, to me, clearly demonstrated the limits of our capabilities. The Phase 3D development is nearing completion. Our next major effort, amateur radio on the International Space Station, is underway. In the near future, we will have to take a hard look at what our next satellite project(s) will be. My personal view is that, to attract the new blood we all agree we need, we will be more successful with smaller satellites with relatively short development times – some involving teaming with universities. While these will probably not provide the breadth of capability of the large satellites, they could well incorporate state-of-the-art technical developments and could attract a larger number of participants by giving them a closer match between time commitment and personal reward.

W3PK: I think that high-orbit satellites which allow easy access for hours at a time will in effect give us *new* amateur bands by making possible operational and dependable communications, especially at VHF, UHF and microwave frequencies.

W3XO: It will convince most that the higher bands are the optimum portion of the spectrum for amateur satellite uplinks and downlinks. I continue to harbor the dream that one of these days AMSAT will provide worldwide 24 hr/day continuous real-time voice and data communications capability for the world's amateurs. Such a system could be used for either direct access by ground stations or as a means of linking repeaters.

W2RS: The economics of space technology have changed dramatically since 1969. As Martin Sweeting, G3YJO (Chairman of AMSAT-UK and CEO of Surrey Satellite Technologies Limited) often says, "there's no longer any such thing as a free launch." Small satellites and *piggyback* launches have become big business, making it far more difficult than ever for purely amateur satellites to get rides into space. Multipurpose spacecraft, having non-amateur as wll as amateur missions will be more common in the years ahead. Another big challenge we face is the growing demand for our VHF and UHF bands by commercial interests, along with the increasing tendency on the part of many governments to auction frequencies to the highest bidder. The recent slowdown in Amateur Radio's growth due to the Internet doesn't help either, but we have overcome similar challenges many times in the past: 200 meters and down (1912); two U.S. wartime shutdowns (1917-19 and 1941-45); broadcast interference (1920s); TVI (1950s); CB boom (1970s)...the list goes on and on. Each time, we changed somewhat as we adapted, but we survived to become stronger than ever. So too will it be, I believe with Internet.

Any closing comments?

W2RS: As I noted earlier, experience has taught me not to try to predict the future. I hope to work all of you, though, on January 1, 2029 in our 57th Annual Straight Key Night on OSCAR. CU then! ■

Each attendent at the AMSAT 30th anniversary celebration held March 13, 1999 at the NASA Goddard Spaceflight Center, Maryland received the above certificate that commerated the event. NASA's partnership with AMSAT to keep Amateur Radio in space continues on a strong footing into the 21st century with ARISS and SAREX programs. **(see page 22)**

UoSAT-12/OSCAR-36 Successfully in Orbit!

Chris Jackson, G7UPN/ZL2TPO

UoSAT-12/OSCAR-36 was successfully launched from the Baikonur Cosmodrome in Russia at 0500 UTC on 21 April 1999 using a converted SS-18 ICBM (Figure 1). Successful confirmation was received of various booster stage separations, as well as payload separation of UoSAT-12 from the booster, 877 seconds after launch, placing the satellite in a 640km by 66 degree inclination orbit. UoSAT-12 switch-on occurred around 1200UTC and a telemetry downlink on 437.400 MHz is available using VLSI telemetry format at 9600bd FSK at 437.400 MHz. Reception reports were received almost immediately following the launch.

Since launch, UoSAT-12 has successfully passed all initial tests, including enabling the on-board and essential bus subsystems. In addition, the command team successfully uploaded flight software to the satellite's primary on-board computer. This multi-tasking software collects telemetry throughout the satellite's orbits, supporting the attitude acquisition phase of the mission. As a result, the on-board software has stopped the tumbling of the satellite after release from the launcher. The momentum wheel on the bird was also tested and confirmed as operational. UoSAT-12 is now in a 3-axis stabilized Earth pointing mode.

The first images of Earth from the four remote sensing CCD cameras on-board the mini-satellite have been successfully received. The first image from the 10-meter resolution panchromatic camera was taken over Texas and later downloaded for evaluation. The image showed good detail, confirming camera function and focus. After adjusting the camera, a second image over London was captured. Also, a panchromatic image and a 32-meter single-band image from one of the two multi-spectral cameras were captured simultaneously over Los Angeles, clearly showing airport runways, housing, dockyards and freeways.

Responding to a question from AMSAT-NA President Keith Baker, KB1SF, the satellite will also officially beknown as UoSAT/OSCAR 36, or simply UO-36.

UoSAT-12 is the latest satellite from the University of Surrey/Nanyang Technology University and it carries a number of imaging payloads (up to 10 meter resolution) along with store and forward communications in VHF/UHF and an L/S band transponder / high speed digital downlink. The satellite is considerably larger than UO-22 or TO-31 and carries a propulsion system for orbital housekeeping experiments (Figure 2). The imaging system comprises a panchromatic imager with 10m resolution and multispectral imager with 40m resolution along with a colour wide angle camera. The S band downlink can run at speeds up to 1Mb/s for downloading imaging data, and can also be used as an LS band analogue transponder.

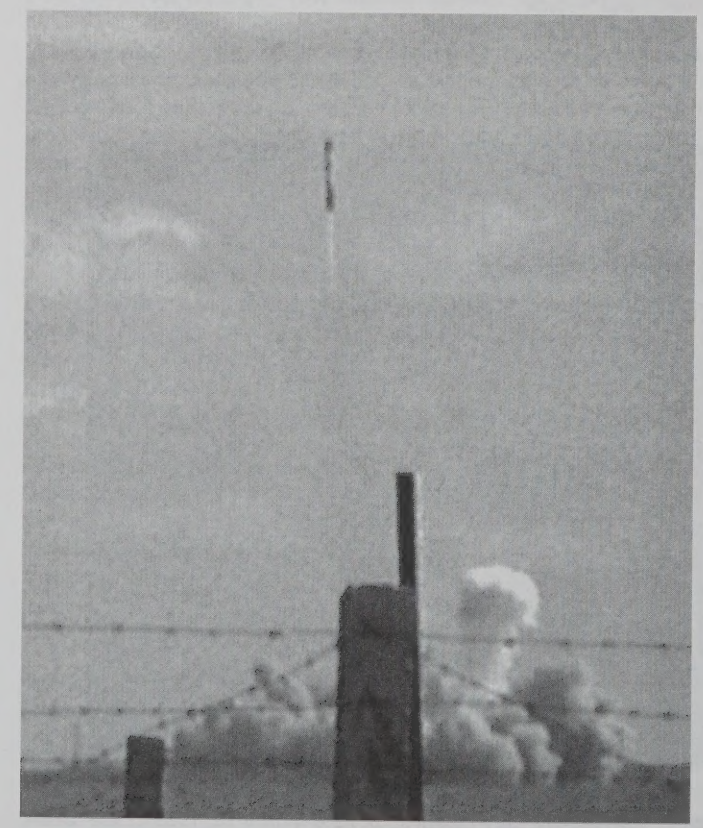


Figure 1. A successful lift off of UoSat-12 from the Baikonur Cosmodrome in Russia at 0500 UTC on 21 April 1999.

The UoSAT-12 Mission

The UoSAT-12 mission is funded as a research and development project within Surrey Satellite Technologies Limited (SSTL) and UoSAT, with invited collaborative payloads from Nanyang Technological University (NTU) in Singapore, and the European Space Agency. The mission is demonstrating the new UoSAT-12 minisatellite platform, and is carrying a wide range of Earth Observation and communications payloads. It builds on bus systems and payloads flown on earlier microsatellite missions, and also carries a number of *next generation* systems to qualify new technology for flight on subsequent missions. UoSAT-12 also carries a sophisticated Earth Observation package, with a high resolution mono-chromatic camera, and a set of multispectral cameras. In support, a high speed S-band downlink will reduce downlinking bottlenecks. Deployable GaAs solar panels provide the available power. The attitude determination and control system provides three axis control using momentum wheels, magnetorquers and gas thrusters. An experimental resistojet thruster provides a means of stationkeeping, and an experimental GPS receiver provides both orbit and attitude determination.[1]

Structure

The MiniBus platform structure supports a payload mass from 50 to 350kg (UO-36 mass is about 350 kg). A minimum orbit average power of 70W is provided increasing to ~150W depending on the sun angle. In a non-sun synchronous orbit, UO-36's power budget changes over a 90-day period. Payloads can either be carried in one or more standard SSTL MiniBus modules in the Module Stacks or in the large Payload frame with aperture access to the Earth-facing facet. Payloads for Earth observation can be carried directly on the nadir-pointing Earth Frame, and space facing payloads are accommodated on the zenith facing facet.

Altitude and Orbital Control

The Orbit Control and Determination System comprises a GPS receiver and a cold gas thruster system. Both are also an integral part of the Attitude Control and Determination System which includes magnetometers, magnetorquers, horizon and sun sensors and an offset momentum wheel system. The three-axis control system maintains Earth pointing to an accuracy of 0.5°, with an experimental target of 0.1°, for Earth observation payloads and communication antennas. The ADCS and OCS are supported by an attitude control processor, which can be any of the four primary on-board processors. The Orbit control system addresses the requirements for constellation phasing, minor orbit adjustments, drag compensation and momentum dumping. This is achieved by a Nitrogen cold gas system, illustrated below. The cold gas system has a total impulse of 4000Ns, and offers a

2000Nm angular impulse. It provides a total velocity change capability of 17.8m/s.

Power System

The power system is comprised of a set of nine deployed solar panels and Battery Charge Regulators, three 6Ah battery packs, a centralized power switching system, and a distributed power conditioning system. Power is distributed and switched via an unregulated 28V bus. The solar panels employ highly efficient GaAs cells, supplying a raw orbit average power of 150W to the platform. Panels are deployed at an angle depending on the orbit and power profile required for the mission. In order to provide prolonged battery cycle life, NiCd cells are used in the 18Ah battery.

Power switching is performed centrally, and full DC isolation is maintained by having power converters at each sub-system. Switching commands are issued over the uplink, or from any active processor on the CAN telemetry and telecommand network.

Communications

The communication system employs VHF and UHF uplinks and downlinks for standard telemetry and telecommand using robust links (Figure 3). These also provide the standard Store and Forward digital transponder service. An S-band 1Mbps downlink supports payloads that generate large amounts of data, such as Earth Observation payloads. The four independent VHF uplinks support 9600 bps shaped CPFSK, while the three UHF downlinks support 9600 and 38,400 bps CPFSK. The dual redundant S-band downlink provides 1Mbps BPSK, with optional Viterbi encoding.

Telemetry and Telecommand

Telemetry and telecommand is a distributed system employing a CAN local area network. Each payload and bus system contains one or more nodes, each of which is implemented using a CAN microcontroller. The network is dual redundant and DC-isolated. Individual systems are shielded and isolated. The 1Mbps, ISO 11898 & 11519-1 CAN network employs DC isolated twisted pair connections, and each CAN node microcontroller can measure local digital and analogue telemetry, and issue local telecommands. It is also possible for it to request remote telemetry, or issue remote telecommands via the network.

The TT&C master is implemented in software, and its function is to collect, format and downlink telemetry and issue telecommands, either direct or programmed. The TT&C master would nominally be the primary on-board-computer, however this architecture allows any other computer, and indeed any of the nodes to perform this function.

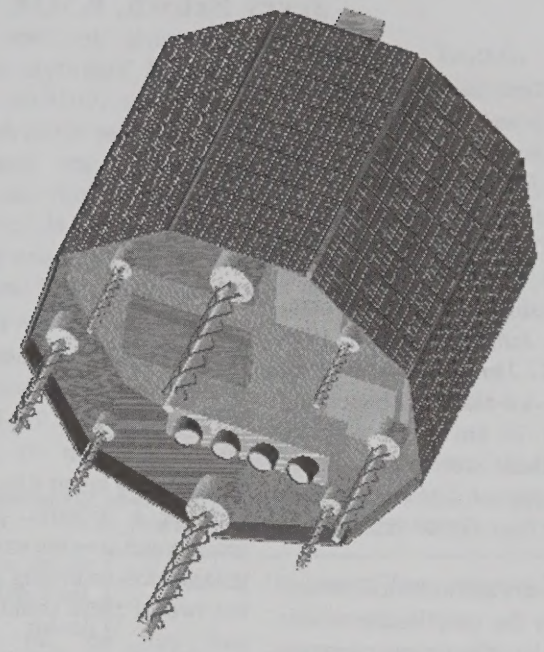


Figure 2. UoSat-12 drawing.

Operating Schedule

The transponder makes use of the full power budget available on the UoSAT-12 minisatellite, and consequently it is the intention to operate the transponder on a schedule to be published regularly. As UoSAT-12 technology checkout and experiments are likely to be closely related to working hours in Britain and Singapore, it is proposed that the Merlion communications transponder will be available outside these working hours and during weekends. Monitor the AMSAT News Service and *The AMSAT Journal* for detailed UoSAT-12 operating schedules and frequencies.

References

1. da Siva Cruiel, R.A., et.al., *The UoSAT-12 Merlion Payload*, Surrey Satellite Technology, Ltd., Center for Engineering Research, University of Surrey, United Kingdom. ■

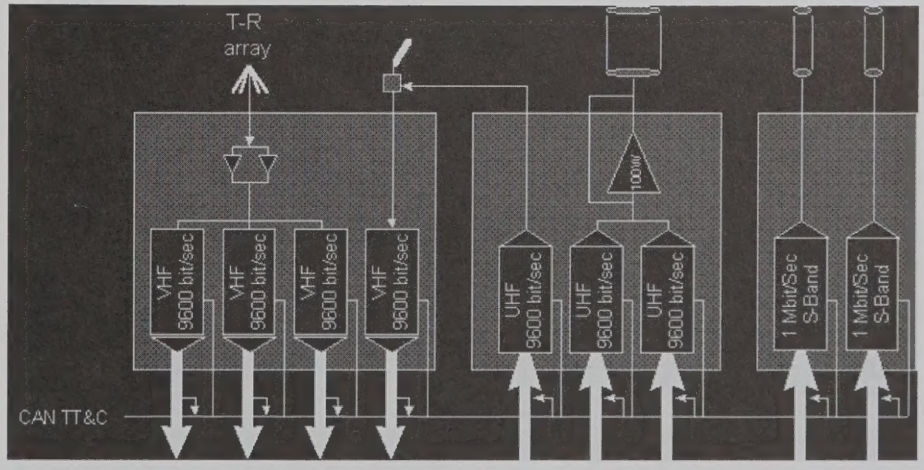


Figure 3. UoSAT-12 communication diagram.

A Modest—But Effective—AO-10 Antenna

Jerry Brown, K5OE (*k5oe@amsat.org*)

The venerable AMSAT OSCAR-10 (AO-10) is still up there making satellite DX contacts and *rag chews* a reality for lots of amateurs. If you have been working the LEO's (Low Earth Orbit) successfully with small antennas (like me), you have probably already discovered much (much!) more gain is required to work AO-10. I have managed a few contacts using my Texas Potato Mashers (see the January/February 1999 issue of *The AMSAT Journal*) as well as my first AO-10 setup—a 4-element 2 meter yagi and an 8-element 70 cm quagi with 10 Watts. However, those were marginal and all occurred when the satellite was near the horizon and closer than 12,000 km.

I longed for better *ears* and more *talk power.* AO-10 is currently the only bird available for ragchews and a lot of European operators are up in the middle of the night for just that reason. Getting on AO-10 more reliably was easier than I thought and you can replicate this design with a trip to the hardware store and four hours of work; and be on the air that evening! For up-to-date information on AO-10, visit AMSAT and Stacey Mills', W4SM, Websites.[1]

AO-10 makes periodic appearances, for weeks or months at a time, where it defies its reputation as being difficult to work. This antenna will get you on with only 10 Watts and is small enough for portable use.

This article describes construction of a dual-band Yagi-style antenna specifically designed for AO-10 use. While I don't want to preclude use of this design for LEO's, the beamwidths are narrow enough to realistically require automated tracking for both azimuth and elevation—which I do not have (yet). The 2 meter portion consists of a stock Cushcaft VHF beam; 7 elements with an advertised 11.1 dBi gain. The 70 cm portion consists of 14 elements and has almost 16 dBi gain at 435.1 MHz. The elements of both antennas are mounted orthogonally on an 8 foot boom. This is a linearly polarized antenna and does not employ any polarization-switching schemes, but two of these could be built and set up for circular polarization and switching: See the *ARRL Antenna Book* or Martin Davidoff's *The Radio Amateur's Satellite Handbook* for examples.

Design

Several design parameters were foremost in my search for a better antenna system for AO-10. First, it needed to be inexpensive (I'm an engineer and that is often the primary design criterion). Second, it had to be small enough to be mounted on my patio-based tripod with *Armstrong* rotator—about 8 foot maximum. Third, since its service was dedicated to mode B, it needed to be optimized for transmit gain and receive S/N ratio.

The 2 meter portion of the prototype started life as a Cushcraft A144-7S I found on the Internet clearance-priced for $40.[2] It is 7 elements on a 7-4" boom. The original design has specifications of 11.1 dBi gain and a 20 dB F/B ratio. I confirmed this with modeling software, YagiMax, and attempted to optimize the design for an improved Front-to-Back (considers largest rear lobe) ratio.[3] This effort proved informative, but the improvement wasn't worth the extra effort (maybe later, since addition of just one more element will appreciably improve the F/B ratio). The stock dimensions are provided in Table 1 for those that may want to build from scratch. This is an above-the-boom design.

Table 1. 7-element 2 Meter Antenna Dimensions. (in inches)

Element	Length	Spacing	Diameter
R	40-1/4	0	3/16
DE	38-7/16	14-1/4	3/8
D1	36-3/4	28-1/2	3/16
D2	36-1/4	42-3/4	3/16
D3	35-3/4	57	3/16
D4	35-1/4	71-1/4	3/16
D5	34-3/4	85-1/2	3/16

The 70 cm design is optimized for transmitting. Almost the same gain could have been achieved with fewer elements on the same length boom, but the additional elements were added to increase the feedpoint impedance—thus improving the radiation efficiency of the antenna. The design has a feedpoint impedance of about 38 Ohms, almost double the typical design. The higher radiation resistance not only improves the efficiency, it also helps flatten the SWR response curve; I observed less than 1.5:1 from 434 to 436 MHz. A gamma match from an old flea market beam was used, but these are easily hand-crafted from aluminum tubing or ordered from Cushcraft as spare parts.[4] See Figure 2 for the azimuth pattern generated by YagiMax and Table 2 for the building dimensions.

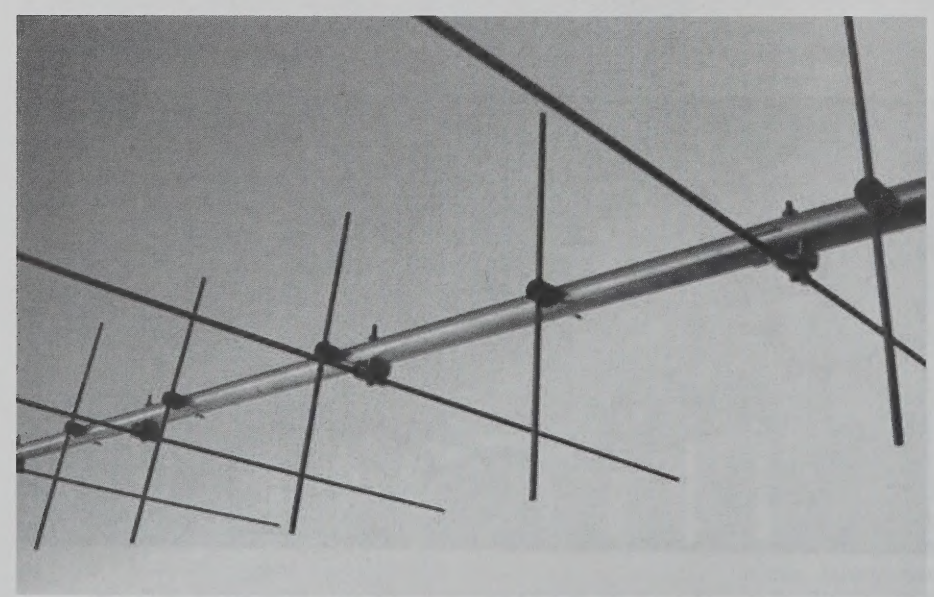


Figure 1. A Small AO-10 Antenna Constructed in the *Arrow Antenna Style.*

Now comes the hard part: How to put them on the same boom and minimize interaction. First, I put them at 90 degrees to each other (similar to the popular Arrow Antenna design).[5] Second, knowing almost half the element current flow on the 2 meter antenna is between the reflector and the driven element, and half of the current flow on the 70 cm antenna is between the reflector and the first director, I opted to *extend* the back of the 7'-4" boom an additional 9" and place the reflector, driven element, and first director of the 70 cm antenna behind the 2 meter reflector. This effectively isolates the high-current portions of each antenna, minimizing distortions to the receive and transmit patterns.

Construction

Materials are not critical, but new calculations would need to be run if different size elements are utilized. Your mileage may vary. The boom is 8' of 1" aluminum tubing (a convenient length available at many hardware stores). The driven elements are 3/8" aluminum rod and all the parasitic elements are 3/16" aluminum rod.[6] I used all stainless steel hardware, sizes 6-32 and 4-40.

Except when it is near perigee, AO-10 moves slowly enough to make a fixed "back yard" tripod mount like this one practical for occasional use. The author has also tested it on AO-27 and FO-29. Field Day?

The 2 meter elements are mounted on small aluminum brackets (Cushcraft P/N 190026). The 70 cm elements are mounted on small rubber *feet* I found at a local surplus electronics shop. There is already a hole drilled through the "bottom" of the feet for running a bolt through the boom. I carefully drilled a slightly undersized hole perpendicularly through the feet and then squeezed the 70 cm elements through the hole for a secure fit. Note all the 70 cm parasitic elements are insulated from the boom. Coating or painting the rubber is advisable to prevent UV deterioration.

A lesson learned on this project was in drilling the holes in the boom. If you have access to a drill press, go use it. If not, an extra hour spent carefully lining up holes on both sides of the boom and at 90 degrees is well worth the extra time. If you look carefully at the photographs, you will note I did not achieve perfect alignment of all elements on the first attempt. Another lesson worth passing on is the length of a resonant driven element *appears* shorter due to the inductive reactance from the parasitic elements. The final, resonant, 70 cm driven element is 1/2" longer than the software model prediction. Coax placement along the boom interacts with the feedpoint and routing the 70 cm feedline off the back of the antenna (like Arrow and KLM) is a preferred technique if it is feasible in your installation.

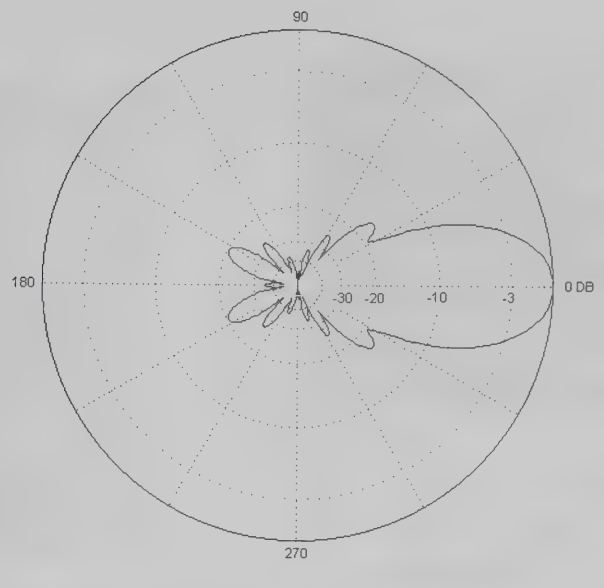


Figure 2. Azimuth Pattern of 14-element 70 cm Antenna. E-Plane Plot produced with YagiMax 3.46, free space at 435.1 MHz., 15.80 dBi.

Table 2. 14-element 70 cm Antenna Dimensions.
(in inches)

Element	Length	Spacing	Diameter
R	12-15/16	0	3/16
DE	12-3/4	5-3/4	3/8
D1	11-15/16	8-1/2	3/16
D2	11-13/16	13-1/8	3/16
D3	11-5/8	18-3/8	3/16
D4	11-9/16	25-1/8	3/16
D5	11-1/2	32-5/8	3/16
D6	11-7/16	40-3/4	3/16
D7	11-3/8	49-1/2	3/16
D8	11-5/16	58-1/2	3/16
D9	11-1/4	67-1/2	3/16
D10	11-3/16	77	3/16
D11	11-1/8	86	3/16
D12	11-1/16	96	3/16

Performance

On Saturday night AO-10 was making a perigee appearance about 14,000 km out over my southern horizon, so I had my just-purchased and assembled 2 meter

Figure 3. Prototype Mounted On Test Tripod.

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(pair with 2MCP14)

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10' 6" boom

2MCP22
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18' 6" boom

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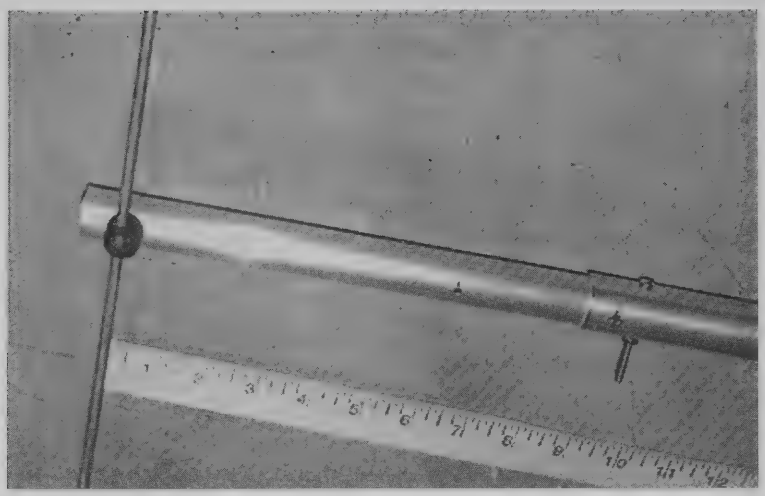

Figure 4. The 70 cm Elements Are Insulated From the Boom. Note the extension to the stock boom and how the elements mount through the *feet*.

antenna on the same tripod as my 8-element quagi uplink antenna. I heard John, KD2JF, call CQ. We had a short QSO: I could hear him great but he had trouble copying me. No one else could hear me. That did it! On Sunday afternoon I built the 70 cm portion described above. On Sunday night, there was John again wrapping up a QSO. I called him. He said: "Hey Jerry, what did you do? I have armchair copy on you." With 10 Watts, I routinely work SSB stations out to 24,000 km and have several in the log at greater than 34,000 km. A CW QSO should be possible at apogee, but I can't claim that one (yet). Next step: Get that baby on a rotator!

Epilog

While this design is specific to the stock Cushcraft antenna I had available, the concepts of orthogonal elements on a single boom and separation of driven elements can be applied to any number of elements. The current Cushcraft *economy* model is a 10 element design on a 12' boom (A148-10S, rated at 13.2 dBi gain). Extrapolating this design to that boom yields a 19 element antenna with over 7.5 dBi of gain, see Table 3!

Notes

1. www.amsat.org and www.cstone.net/~w4sm/AO-10.html.

2. www.RadioDan.com, Fresno, CA.

3. Lew Gordon, K4VX, k4vx@nemonet.com. YagiMax 3.46 is available from the author via e-mail as an attachment at no charge, or by direct mail for $3.00.

5. www.Cushcraft.com, Manchester, NH.

6. Allen Lowe, N0IMW, http://members.aol.com/arrow146/index.html.

7. 3/8" tubing and 3/16" rod available from Texas Towers, Plano, TX. ■

Table 3. 19-element 70 cm Antenna Dimensions. (in inches)

Element	Length	Spacing	Diameter
R	12-15/16	0	3/16
DE	12-3/4	5-3/4	3/8
D1	11-15/16	8-1/2	3/16
D2	11-13/16	13-1/8	3/16
D3	11-5/8	18-3/8	3/16
D4	11-9/16	25-1/8	3/16
D5	11-1/2	32-5/8	3/16
D6	11-7/16	40-3/4	3/16
D7	11-3/8	49-1/2	3/16
D8	11-5/16	58-1/2	3/16
D9	11-1/4	67-1/2	3/16
D10	11-3/16	75-1/2	3/16
D11	11-1/8	85-1/2	3/16
D12	11-1/16	96-1/4	3/16
D13	11	108	3/16
D14	10-15/16	120	3/16
D15	10-7/8	132	3/16
D16	10-13/16	144	3/16
D17	10-5/8	156	3/16

Current Amateur Radio Satellite Frequencies

Andy Reynolds, WD9IYT

Analog Satellites

Satellite	Beacon	Uplink (MHz)	Downlink (MHz)[1]	Mode
AO-10[2]	145.810 & 145.987[3]	435.030-435.180 LSB/CW	145.975-145.825 USB/CW	U/V
AO-27		145.850 FM	435.800 FM	V/U
FO-20	435.795[4]	145.900-146.000 LSB/CW	435.800-435.900 USB/CW	V/U
FO-29	435.795	145.900-146.000 LSB/CW	435.800-435.900 USB/CW	V/U
RS-13	29.504	21.260-21.300 USB/CW	29.460-29.500 USB/CW	A
RS-13	29.504	21.260-21.300 USB/CW	145.960-146.000 USB/CW	KT
RS-13	29.504	145.960-146.000 USB/CW	29.460-29.500 USB/CW	KA
RS-15[5]	29.352	145.858-145.898 USB/CW	29.354-29.394 USB/CW	KA
SO-35[8]		145.825 FM	145.825 FM (Parrot repeater)	

Digital Satellites

Satellite	Name/Call Sign	Uplink (MHz)	Downlink (MHz)[1]	Mode
UO-11			145.825 FM	1200 Baud PSK
AO-16	PACSAT	145.900, .920,. 940, .960 FM	437.0513 FM	1200 Baud PSK
DO-17	DOVE		145.825 FM	1200 Baud AFSK
WO-18[6]	WEBERSAT		437.104 SSB	1200 Baud PSK AX.25
LO-19[7]	LUSAT	145.840, .860, .880, .900 FM	437.1528 SSB	1200 Baud PSK AX.25
UO-22	UoSAT5	145.900, .975 FM	435.120 FM	9600 Baud FSK
KO-25	HL02	145.890 FM	436.500 FM	9600 Baud FSK
IO-26	ITMSAT	145.875, .900, .925, .950 FM		
FO-29	8J1JCS	145.850, .870, .890, .910 FM	435.822 SSB	1200 Baud PSK
TO-31	TMSAT-1	145.925, .975 FM	436.925, .900, .975 FM	9600 Baud FSK
GO-32	TECHSAT 1B	145.850, .890, .930 FM 1269.700, .800,. 900 FM	435.325, .225 FM/USB	9600 Baud FSK
SO-33[8]	SEDSAT-1	145.915 – 145.975 USB	437.850 – 438.000 FM	9600 Baud FSK
PO-34	PANSAT	436.500 FM	436.500 FM	9600 Baud Spreadspectrum
SO-35[9]	SUNSAT	145.825, .850, .900, .950 FM 436.250, .300 FM	436.300 FM	9600 Baud AFSK 1200 Baud FSK
UO-36	UoSAT-12		437.400 FM	38.4K & 9600 Baud FSK

Human Space Flight

Spacecraft	Name/Call Sign	Uplink (MHz)	Downlink (MHz)[1]	Mode
Mir	R0MIR	145.985 FM	145.985 FM	Voice, Packet, SSTV
Mir[10]	SAFEX II	435.750 FM	437.950 FM	Repeater
Mir[10]	SAFEX II	435.725 FM	437.925 FM	Voice
SAREX	W5RRR	144.490 FM[11]	145.550 FM	Packet
SAREX	Various	144.910, .93, .95, .97, .99 FM[11]	145.550 FM	Voice

Notes:

1. Frequencies are shown without Doppler compensation. At the start of a typical LEO pass, the original signal will be several kHz higher than shown above. Refer to specific satellite operating instructions for complete details.
2. AO-10 is no longer controllable but the transponder works when the satellite is in sunlight.
3. AO-10 beacon is an unmodulated carrier. Do not transmit to the satellite if the beacon is FMing.
4. Presently, FO-20 beacon is not operational.
5. Try RS-15 *meeting frequency* at 29.380 MHz.
6. WO-18 is currently not in operation.
7. LO-19 is currently semi-operational.
8. SO-33 is currently unavailable for uplink transmissions as recovery efforts have been unsuccessful.
9. SO-35 has not yet been activated. Voice parrot repeater on 145.825 MHz.
10. Mir SAFEX II is seldom operational. There is a 141.3 Hz tone on repeater and 151.4 Hz tone on voice.
11. These are typical SAREX uplink frequencies. Refer to AMSAT News Service bulletins for exact frequencies prior to mission.

Next Generation Launch Vehicles: *The Roll-Out of the Roton/ATV*

Ian Kluft, KO6YQ (*ikluft@thunder.sbay.org*)

On the sunny but windy morning of March 1, 1999, over a thousand people converged on the Mojave Airport in the Southern California desert. They came from all over California and across the country to see the first public unveiling of Rotary Rocket Company's *Roton* Atmospheric Test Vehicle (or just Roton/ATV.)

This was a roll-out ceremony just like for a new kind of aircraft. As they opened the hangar doors, everyone watched eagerly to see what was inside. But this wasn't just another aircraft. The Roton/ATV is a full-size prototype of the Roton single-stage to orbit (SSTO) reusable rocket, which Rotary plans to roll out early next year.

Though Rotary isn't the only one working on something like this, they're the first to roll out flight hardware. To many attendees of the roll-out, there was a feeling of history in the making. The idea of a lower-cost launch vehicle just crossed the threshold from science fiction to reality.

Let's take a look at why this is important to amateur satellite builders...

The Race to Lower Launch Costs

It doesn't take a rocket scientist to figure out that if the space launch industry can bring down the costs of a launch to orbit, one way or another it will improve access for amateur satellites too. Amateur Radio operators and other amateur satellite experimenters squeeze satellites into the flow with the help of generous sponsors, usually when a commercial launch has room and weight to spare.

But as we've found out with Phase 3D, the larger the satellite, the harder it is to make the arrangements for launch. Anything that makes launches easier should trickle down to better access for amateurs too.

We've all heard ideas for years about how to make space launches less expensive. Since the late 1980's, there has been commercialization of expendable launch vehicles (ELVs) such as Europe's Ariane, Boeing's Delta, Lockheed-Martin's Titan, Orbital Sciences' Pegasus, Russia's Soyuz, Ukraine's Zenit, China's Long March and others. Competition has improved efficiency and brought prices down a little bit. But since they're not reusable, every launch customer pays for the whole rocket as part of the service. That's why prices can't go much lower for ELVs. Prices are about $10,000 per pound of payload on today's ELVs.

The Space Shuttle, while it made enormous advances, failed on its original premise of bringing launch costs down. It still takes a small army of expensive technicians to turn around the vehicle and launch it again. So shuttle launch costs aren't even competitive with ELVs. It's the launcher for the *performance at any price* market, since it can still do things no other launcher can.

Nonetheless, over the past 18 years, the shuttle program has shown that you can reuse a launch vehicle. Entrepreneurs today are actively developing ways to make that concept economical.

The biggest factor driving development of more economical space launches is demand from customers. Amateurs can claim some credit in the history that led up to this. We Hams and our Orbiting Satellites Carrying Amateur Radio (OSCARs) proved that satellites in Low Earth Orbit (LEO) are actually usable for reliable communications. Then companies like Iridium, Globalstar and Teledesic designed communication systems based on whole *constellations* of LEO communications satellites. Once a constellation is up, there's a never-ending schedule of replacement satellite launches. Those projects lead the new insatiable demand for launch services. Anyone who builds a lower-cost launcher is guaranteed a steady stream of customers. Money talks.

Reusable Launchers Under Development

Rotary Rocket is one of more than half a dozen companies, mostly start-ups, working on lowering launch costs. Companies are aiming for a price point of $1000 per pound to orbit (for a launcher's full payload.)

A quick look at the industry shows that everyone has a different approach to bringing costs down. Helicopter rotors, in-flight refueling and glider-like towing are among the tricks being developed. The only thing in common among them is partially or fully-reusable systems. So these are called Reusable Launch Vehicles (RLVs). They save money because the vehicle returns to fly again. So the customer doesn't have to pay for the whole rocket just to launch a payload.

Rocket science is known for its difficulty. But hopefully at least several of these projects will succeed. There are start-up companies like Rotary Rocket, Pioneer Rocketplane, Kistler Aerospace, Kelly Space & Technologies and a handful of

A view of the TV crew platform, Roton/ATV and crowd. Attendees' vehicles are parked on the Mojave Airport ramp in the background. Beyond them are the airport's taxiways and runways. Hills in the Mojave Desert are visible in the far background.

others. Lockheed-Martin is building a NASA-funded half-scale demonstrator called the X-33.

None of them though is guaranteed to succeed. The start-ups are all looking for more investors. And it remains to be seen if Lockheed has bitten off more technology than it can chew with the X-33.

Keep watching them for progress and news. SSTO has still never been done. But rocket scientists are certain it can be done with today's technology. Someone just has to build it.

The Roton/ATV Roll-out

So now you've got an idea what a big deal people made about the Roton/ATV roll-out. Finally one of those lower-cost space launch ventures has hardware to show off. It's a good start.

The Roton/ATV itself will only fly within the atmosphere to test the helicopter-like landing approach. It's similar in concept to what the Space Shuttle prototype *Enterprise* did, testing its landings in the late 1970's at Edwards Air Force Base, just 15 miles east of Mojave.

Everything went fine at the roll-out except for heavy wind. I monitored the Mojave Airport Tower on my HT and heard winds usually between 25-35 knots (28-40 mph.) Rotary's hangars were in the right position to shield us from the worst of the wind. But the microphone sometimes picked it up like a jet engine.

The roll-out ceremony was televised live via satellite and on the Internet. The master of ceremonies was Rick Tumlinson of the Space Frontier Foundation. He told us how long so many people had been waiting for that day. The Mojave Airport Manager, Dan Sabovich, welcomed us to his facility. Novelist Tom Clancy, a Rotary Rocket investor and member of their Board of Directors, told us that it's important to have dreams and that day some people's dreams were being realized.

Patricia Grace Smith, FAA Associate Administrator for Commercial Space Transportation, said that the FAA had only recently been given authority by Congress to license commercial re-entry vehicles. She was glad to begin to do so. The crowd cheered, which really surprised her. Apparently FAA people don't get that reaction often.

NASA Chief Engineer Dr. Daniel Mulville pointed out that NASA's role is to explore space but it's up to private industry to exploit it.

Then Rotary Rocket CEO and founder Gary Hudson spoke. He willingly discarded a 9-page speech he had written, to shorten the time the crowd had to sit in the high winds. He quickly gave credit to the researchers and experimenters who had set the foundations for this dream. All the people at Rotary Rocket and its contractors were credited for their hard work. He also credited Rotary's CTO Bevin McKinney with the original idea for Roton. A lot of people mistakenly credit Hudson with the idea so he wanted to set that straight.

Then came the big moment. All of the speakers had been standing in front of the closed doors of Rotary's *high bay* hangar. This hangar looks like a scaled-down version of NASA's Vehicle Assembly Building (VAB) at Kennedy Space Center. When they opened the tall doors, sliding the sections away to the sides, they revealed the 63-foot tall Roton/ATV. It's a rounded-top tall conical shape with four helicopter rotors on the top. (Next year's space-flight version of Roton will be able to stow the rotors down its sides for launch.)

It was pulled out in the upright position, using a normal aircraft tug that can be found at any airport. As they pulled it out of the hangar, the markings became visible, including the aircraft registration number *N990RR Experimental* on the sides. Facing forward was the crew cabin, with room for two pilots.

In that moment, science fiction turned to reality. Cameras clicked away. The crowd came down from the stands and gawked around it. Rotary eventually rolled it back in to get it out of the winds. The 35-knot winds were half of the 70 knots that the vehicle is designed to withstand when parked. But understandably they weren't taking chances with their new baby.

Then the event proceeded to a catered lunch in the low bay hangar and a press conference in the high bay. I heard that Rotary had to cater the lunch because there were three or four times as many attendees as the capacity of all the restaurants in Mojave. The whole thing from beginning to end was a first class job, including the lunch.

This was one of those *everyone was there* events, if you knew whom to look for. Unfortunately, I didn't. Space entrepreneurs, authors and enthusiasts filled the place. Some of my friends introduced me to Michael Kelly of Kelly Space & Technology, and some of the company's other officers. (So Rotary obviously invited their competition.) From a distance, they also pointed out technology and sci-fi author Jerry Pournelle, and some actors from *Babylon 5*. Other friends said they ran into Pete Conrad (Apollo 12 commander, third

A view up the stairs to the crew cabin. There was a long line to get up there (not shown in picture.)

World-famous aircraft designer Burt Rutan was among the attendees. His company, Scaled Composites, which is also located at the Mojave Airport, made the composite structure for Roton/ATV.

man on the Moon.) The list goes on. They were everywhere.

Since my background is with aviation, I was only able to recognize one celebrity without help. I saw Burt Rutan, the famous aircraft designer whose Voyager airplane flew non-stop unrefueled around the world, from and back to the Mojave Airport. Rutan's company, Scaled Composites, made the light but strong composite structure of the Roton/ATV.

I had attended with other members of the Experimental Rocket Propulsion Society (ERPS) from Silicon Valley in Northern California. One of our members works for Rotary and arranged for our invitations. I hope we'll be invited again next year for the roll-out of Roton/PTV, Rotary's space-flight prototype test vehicle.

Rotary estimates that their commercial launch services will be priced at US$7 million for 7000 pounds to LEO. Their plans are for Rotons to launch from and return to land at the Mojave Airport. Interestingly, most of this new generation of space entrepreneurs and enthusiasts associate launch *countdowns* with government inefficiency. Expect to hear *cleared for takeoff* when these birds fly.

What About Amateur Radio Satellites?

At the time I'm writing this, Phase 3D is still looking for its ride to orbit on an Ariane launcher. But we all know we've all been waiting a long time. The high costs of getting a launch to orbit underlie the circumstances behind many of Phase 3D's launch delays, and the difficulties for all amateur satellites.

So whether you know it or not yet, you want projects like Rotary's Roton and their competitors to succeed. There will need to be enough inexpensive launcher capacity to handle the demand before prices follow the costs down.

Once that happens, lower prices will mean smaller burdens for launch sponsors and spare room for an amateur satellite. The first decade of the 21st century is looking brighter. Let's make sure we've got satellites ready for launch when the capacity increases.

Web Resources

Rotary Rocket Company:
http://www.rotaryrocket.com/

Kelly Space & Technology:
http://www.kellyspace.com/

Kistler Aerospace: http://www.kistleraerospace.com/

Pioneer Rocketplane: http://www.rocketplane.com/

Lockheed-Martin X-33/VentureStar Site:
http://www.venturestar.com/

Space Frontier Foundation:
http://www.space-frontier.org/

Space Access Society: http://www.space-access.org/

Experimental Rocket Propulsion Society (ERPS):
http://www.erps.org/

Pictures of the Roton/ATV Roll-out:
http://www.kluft.com/~ikluft/pics/rr-atv-ro/

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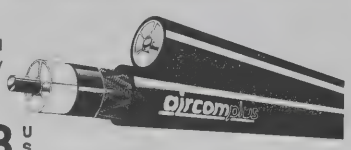

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Field Ops Update: 1999 Dayton Hamvention Highlights

Barry Baines, WD4ASW

Another Success! Through the efforts and hard work of a number of volunteers, AMSAT enjoyed another outstanding weekend at the Dayton Hamvention. The annual event was marked by several notable achievements:

- At the AMSAT Forum on Saturday morning, AMSAT-NA President Keith Baker, KB1SF read a letter from Dr. Karl Meinzer, DJ4ZC, Phase 3D Team Leader which provided updated information regarding progress towards obtaining a launch for Phase 3D.
- As part of the AMSAT Forum, an overview of Amateur Radio on the International Space Station (ARISS) featured Roy Neal, K6DUE and Owen Garriott, W5LFL discussing the significance of amateur radio to the Human Space Flight Program.
- A Beginner's presentation (*Introduction to Amateur Satellites*) by Barry Baines, WD4ASW given during the AMSAT Forum and copies of the *Amateur Satellite Resource Guide* was provided to participants. This introductory talk was supplemented by AO-27 demonstrations by Jerry Schmidt, KK5YY on Saturday and Sunday.
- The AMSAT booth featured a number of items of interest to amateur satellite enthusiasts.
- The AMSAT Dinner at the Amber Rose Restaurant on Friday evening was well attended with excellent food and a great opportunity to socialize with satellite enthusiasts from around the world.

The Hamvention weekend of May 14-16 provided a wonderful opportunity to socialize, view the latest products, and take home some bargains. Dayton continues to be the premier hamfest in North America with throngs of people, acres of fleamarkets and commercial exhibits, a strong forum/presentation schedule, and 'unoffical' events on Friday and Saturday evenings. AMSAT traditionally maintains a strong presence at Hamvention, with a very large booth display, an outstanding forum presence, and opportunities for people to obtain the latest AMSAT materials and information.

Preparations for Dayton began months in advance of the actual Hamvention weekend. As in prior years, Martha Saragovitz coordinated the myriad of details necessary for getting materials to Dayton. The printing of AMSAT materials, developing the latest in AMSAT fashions (such as the 30th Anniversary shirts), ordering stock (such as the Arrow Antennas) and shipping the boxes to Dayton are just some of the functions that Martha performed in preparation for Hamvention. Meanwhile, other folks were busy preparing presentations, updating AMSAT publications and offering new items such as the Phase 3D Model by Steve Thompson, W5PK. All of this effort came together the day before Hamvention when a group of volunteers arrived in Dayton on Thursday to setup the AMSAT booth. Once again, AMSAT was at its usual site (445-448). Setup took most of the day with the assistance of KB1SF, WB8IFM, WA1QXR, K9EK, W5IU, WD4ASW, W3OTC, WA3GOV, and others. AMSAT continues to utilize the booth materials built by Mike Crisler, N4IFD and which are stored in the Dayton area. Booth decoration emphasized AMSAT-NA's 30th Anniversary celebration. Posters that were prepared for AMSAT's 30th Anniversary Dinner in March were displayed at Dayton to help tell the story of AMSAT's history.

The commercial exhibit area opened at 1000 on Friday versus 1200 in prior years. As in the past, a number of volunteers were available to man the booth throughout the weekend. As Bob Carpenter, W3OTC had brought the AMSAT office computer to Dayton, Office Manager Martha Saragovitz and Bob Carpenter, W3OTC handled membership matters, WISP registrations, and other administrative items. As in previous years, AMSAT enjoys a large number of membership renewals as attendees stop by the booth each year to pay their dues. AMSAT was the only provider of NOVA-32 at the Hamvention, so there was a greater than usual interest in the product at the booth this year versus prior years. Keith Pugh, W5IU, Howard Zisserman, WA3GOV, Jerry Malin, N2VV and others were kept very busy demonstrating NOVA on two different computers. W5IU had brought his computer from Ft. Worth to provide support for this effort.

New or updated products available from AMSAT this year at Dayton included:

- The latest version of the Arrow Antenna was offered which features a 'split boom' for easier storage. AMSAT had in stock the complete

Thomas Lubbers, K8TL displays a variety of AMSAT information available to Hamvention attendees.

Jerry Schmitt, KK5YY provided AO-27 demonstrations for Hamvention participants using an Arrow Antenna, HT, and Palmtop computer.

antenna which includes the duplexer built into the handle. We also offered just the split boom for those who already had an Arrow Antenna and wanted to replace their existing single piece boom with the new split boom.

- AMSAT 30th Anniversary Golf Shirts which were blue shirts featuring *30 Years in Space 1969-1999* beneath the AMSAT logo. These shirts were very popular.
- AMSAT 30th Anniversary T-shirts which also highlighted 30 years in space but also included five satellites (including AO-10, Phase 3D, and a Microsat) orbiting around the earth.
- AMSAT 30th Anniversary patch featuring a design similar to the T-shirt
- Phase 3D card stock model kit developed by Steve Thompson, W5PK. Two completed models were on display and generated a great deal of interest.
- Updated Frequency Chart developed by Bill Tynan, W3XO. The new chart includes UoSAT-12 frequencies as well as the latest available information on the various satellites launched in past 12 months.
- *Working the Easy Sats* originally written by Gary Rogers, WA4YMZ and updated by Mike Seguin, N1JEZ.
- *MacDoppler* tracking software for the Apple Macintosh computers. Don Agro, VE3VRW developer of the program brought his I-MAC and interfaced it with the new Yaesu 5500 Rotor (owned by Lou McFadin, W5DID) to provide a working demonstration of how the software can be used. Excellent graphics and the ability to work various doppler shift schemes were amply demonstrated.
- As a membership promotion, AMSAT offered a free copy of *Mode S: The Book* by Ed Krome, K9EK to new and renewing memberships at Dayton.

A 'help wanted' request was posted on AMSAT-BB on May 3 and a number of members stepped forward to volunteer some time to man the booth during the Hamvention itself. Thanks to the people who volunteered, we were able to assign an individual to each of the six workstations for all day Friday and Saturday and most of Sunday. We also had several people 'show up' at Dayton and volunteer to work various shifts. As a result, there were plenty of volunteers to assist the multitudes of attendees who wanted to establish or renew a membership, get an overview of *NOVA for Windows*, pickup the latest AMSAT publications, obtain an Arrow Antenna, or acquire a new AMSAT T-shirt or golf shirt. A total of 26 volunteers were assigned to various workstations at the booth during the course of the weekend.

Hamvention is not only known for the extensive flea market and commercial areas, but also for the opportunity to socialize with folks from around the world. The annual AMSAT dinner was held at the Amber Rose Restaurant in old North Dayton. Organized by Gerd Schreck, WB8IFM, and assisted by Ed Collins, N8NUY, about 50 AMSAT enthusiasts enjoyed a buffet spread that was well prepared and moderately priced. The group consensus was that AMSAT should have next year's gathering at the same location.

The AMSAT Forum was perhaps one of the best series of presentations given in several years. Moderated by AMSAT Executive Vice President Robin Haighton, VE3FRH, the Forum featured three outstanding programs. With an overflow crowd attending the 0815-1030 Saturday morning session, Barry Baines, WD4ASW led off with a 40 minute overview *Introduction to Amateur Satellites* that was aimed at newcomers as well as provided ideas to experienced users on how they might provide information to newcomers back home. One of the messages conveyed during Barry's presentation was the ease of using AO-27. He introduced Jerry Schmitt, KK5YY to the audience and announced that Jerry would do one AO-27 demonstration on Saturday and two on Sunday. Jerry was very successful doing his AO-27 demos with large crowds on hand both days to watch and learn how to work amateur radio's only FM satellite. As part of the presentation, attendees also received a copy of *The Amateur Satellite Resource Guide* which provides an excellent overview of sources of information pertaining to amateur satellites.

Phase 3D Spacecraft Status and Launch Prospects generated a lot of audience interest as AMSAT President Keith Baker, KB1SF read a letter from Dr. Karl Meinzer, DJ4ZC concerning continuing negotiations for a launch. As this letter is presented on page 1, it won't be repeated here. Following Keith's remarks, Phase 3D

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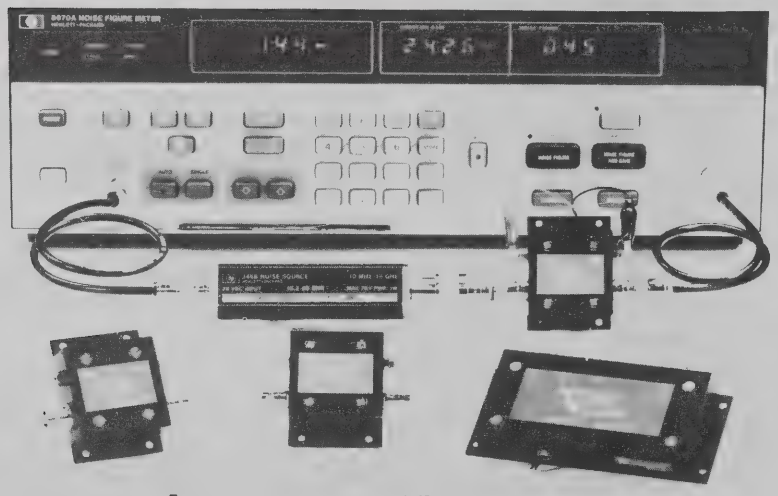

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P50VDG	50-54	<0.5	24	+12	GaAsFET	$79.95
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P144VDG	144-148	<0.5	24	+12	GaAsFET	$79.95
P220VD	220-225	<1.8	15	0	DGFET	$29.95
P220VDA	220-225	<1.2	15	0	DGFET	$37.95
P220VDG	220-225	<0.5	20	+12	GaAsFET	$79.95
P432VD	420-450	<1.8	15	−20	Bipolar	$32.95
P432VDA	420-450	<1.1	17	−20	Bipolar	$49.95
P432VDG	420-450	<0.5	16	+12	GaAsFET	$79.95
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SP28VD	28-30	<1.2	15	0	DGFET	$59.95
SP50VD	50-54	<1.4	15	0	DGFET	$59.95
SP50VDG	50-54	<0.55	24	+12	GaAsFET	$109.95
SP144VD	144-148	<1.6	15	0	DGFET	$59.95
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SP144VDG	144-148	<0.55	24	+12	GaAsFET	$109.95
SP220VD	220-225	<1.9	15	0	DGFET	$59.95
SP220VDA	220-225	<1.3	15	0	DGFET	$67.95
SP220VDG	220-225	<0.55	20	+12	GaAsFET	$109.95
SP432VD	420-450	<1.9	15	−20	Bipolar	$62.95
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Integration Laboratory Manager Lou McFadin, W5DID outlined progress on preparing the satellite for launch. Lou stated that when a launch is available, the satellite will be ready.

The SAREX Working Group chaired by Roy Neal, K6DUE, presented *Amateur Radio on the International Space Station.* Roy provided an overview of the history of SAREX and provided background on how amateur radio was given permission to be on board the Shuttle as the *Shuttle Amateur Radio Experiment.* He then gave the floor to Owen Garriot, W5LFL who was the first Astronaut to use amateur radio from the space shuttle on STS-9 in 1983. Owen discussed the importance of Amateur Radio on the shuttle and the increasing importance that amateur radio will play on the International Space Station. AMSAT VP-Human Space Flight Frank Bauer, KA3HDO briefed the audience on the multiphase approach being taken to equip the ISS with amateur radio with the first phase to take place this December. Matt Bordelon, KC5BTL, SAREX/ISS Principal Investigator and Director of ARRL Educational Activities Rosalie White, WA1STO rounded out the discussion with overviews how amateur radio will be installed on the ISS and the educational impacts on ARISS and SAREX.

Without question, the good news about Phase 3D coupled with having Roy Neal and Owen Garriot available to highlight the importance of amateur radio on the ISS resulted in an outstanding program.

Once again, AMSAT made a significant impact on the Dayton Hamvention through the quality and variety of forum presentations, a very active and professional booth display, and the opportunity to socialize and exchange ideas. Many thanks to the dedicated, hard-working volunteers who helped make our efforts such a success by volunteering to construct and man our exhibits, answer the many questions that were asked about the amateur satellite program, soliciting memberships, demonstrating AO-27, and encouraging support for AMSAT through donations received for our AMSAT materials. As always, Dayton Hamvention was both physically demanding and a fun filled weekend coupled with a great sense of teamwork and cooperation that resulted in another success for AMSAT. Thanks!

Dayton Volunteers

Many thanks to the following members who volunteered a portion of their time at Dayton to help make AMSAT one of the best looking and most informative exhibits are at the Hamvention.

- Don Argo, VE3VRW, Scarborough, Ontario, Canada
- Barry Baines, WD4ASW, Jacksonville, FL
- Keith Baker, KB1SF, Xenia, OH
- Alan Biddle, WA4SCA, Franklin, TN
- Bob Carpenter, W3OTC, Rockville, MD
- Ken Chaffee, WA1QXR, Warwick, RI
- Steve Diggs, W4EPI, Lilburn, GA
- Ronnie Fitch, N6SHI, Hollywood, CA
- James French, KD4DLA, Lincoln Park, MI
- Jim Keeth, AF9A, Indianapolis, IN
- Ed Krome, K9EK, Columbus, IN
- Al Lark, KD4SFF, Greenville, SC
- Thomas Lubbers, K8TL, Springfield, OH
- Jerry Malin, N2HV, Matthews, NC
- David New, WB4SBE, Ann Arbor, MI
- Anna Carolyn Osborne, WS4Z, Roan Mountain, TN
- Keith Pugh, W5IU, Ft. Worth, TX
- Martha Saragovitz, Silver Spring, MD
- Dieter Schliemann, KX4Y, Huntsville, AL
- Jerry Schmitt, KK5YY, Los Alamos, NM
- Andy Skattebo, KA0SNL, Emmetsburg, IA
- Gould Smith, WA4SXM, Knoxville, TN
- Steve Thompson, K5PK, Pfafftown, NC
- Russ Tillman, K5NRK, Vicksburg, MS
- Bill Tynan, W3XO, Kerrville, TX
- Howard Ziserman, WA3GOV, Oklahoma City, OK

From left to right, Roy Neal, K6DUE; Owen Garriot, W5LFL; Matt Bordelon, KC5BTL; Rosalie White, WA1STO; Frank Bauer, KD3HDO; and Lou McFadin, W5DID answering ARISS and Phase 3D questions at the AMSAT Forum.

After a long day of Hamvention, Ken Chaffee, WA1QXR (l) and Harold Reasoner, K5SXK (r) enjoy a well-deserved rest at the AMSAT Dinner.

1999 AMSAT Field Day Competition

Andy MacAllister, W5ACM (*w5acm@amsat.org*)

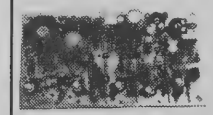
Field Day is once again just around the corner beginning at 1800 UTC on June 26th for a 24-hour period. We are proud to announce the 1999 AMSAT Field Day Competition. It is open to all Amateur Radio operators. U.S. and Canadian amateurs are to exchange ARRL section and Field Day transmitter class. Foreign amateurs should exchange country name and signal reports. Last year's effort was very successful. The AMSAT competition is to encourage the use of all Amateur Radio satellites, both analog and digital. CW contacts and digital contacts are worth three points as outlined below.

Here are the rules for the 1999 AMSAT Field Day competition.

Analog Transponders

- Each satellite transponder is considered a separate band.
- All phone QSO's and all CW QSO's on a given satellite transponder are considered separate bands.
- All packet/RTTY/ASCII/AMTOR QSO's through analog transponders are counted as CW QSO's.
- Phone QSO's count for one point and CW QSO's count for three points.
- Cross-mode (CW-phone) contacts are not allowed.

GET THE ATV BUG!



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TXA5-RC - $129
1.5 watt 70cm ATV Transmitter board - Comes stuffed, soldered & tested with one 70cm crystal - 426.25 MHz suggested, R/C and rocket app note. 2.25x4.0" - req. 12 to 14 Vdc @ 300 ma. Same transmitter but with sound, model KPA5, 3.25x4.0" board - $169. TVC-4G Downconverter - $89 - and your TV set watches the action. Use your 70cm satellite beam. See ARRL Hbk page 12.46.

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- The use of more than one transmitter at the same time on a single satellite transponder is prohibited.

Digital Transponders

- For the Pacsats (LO-19, KO-23, etc.) each satellite is considered a separate band. Do not post "CQ" messages. Simply upload one greeting message to each satellite and download as many greeting messages as possible from each satellite. The subject of the uploaded file should be posted as Field Day Greetings addressed to ALL. The purpose of this portion of the competition is to demonstrate digital satellite communications to other Field Day participants and observers.
- The following uploads/downloads each count as a three point digital contact:
  - Upload of a Satellite Field Day Greetings file (one per satellite).
  - Download of Satellite Field Day Greetings files posted by other stations. Other non-Field Day files are not to be counted for the event.
- Satellite digipeat QSO's do not count for any score and the use of gateway stations to uplink/downlink is not allowed.
- The MIR PBBS is not to be used for Field Day operations.
- If FO-20 or FO-29 are active, the JA transponder can be used for analog CW and phone activities under the analog transponder rules, and the JD system can be used as a separate transponder under the digital rules.

Sample Satellite Field Day Greetings File

Greetings from K5DX Field Day Satellite station near Brenham, Texas with 20 participants, operating class 2A, in the AMSAT-Houston group. All the best and 73!

Note that the message stated the call and name of the group, where they were located and how many were in attendance.

Operating Class

Stations operating portable and using emergency power (as per ARRL Field Day rules) are in a separate operating class from those at home connected to commercial power. On the report form simply check off Emergency or Commercial for the Power Source and be sure to specify your ARRL operating class (2A, 1C, etc.).

The Satellite Summary Sheet (Figure 1) should be used for submittal of the AMSAT Field Day competition results to Andy MacAllister W5ACM, Vice President, User Services, 14714 Knights Way Drive, Houston, TX 77083-5640. You can also send your submission by e-mail to amacalli@danielind.com. Make sure to also send your Field Day photographs with your submission as results will be printed in *The AMSAT Journal*. Deadline for submissions is August 1, 1999.

Competition was tough in 1998 and with additional satellites in orbit, it should be even tougher in 1999. There were some difficulties with various interpretations of the digital rules. When in doubt, don't count it. If your score is in the top five, you will be requested to submit dupe sheets for analog contacts and DIR listings and downlinked files for digital contacts.

The station submitting the highest score for portable operation using emergency power will receive a plaque at the AMSAT Annual Meeting and Space Symposium to be held in San Diego, CA from October 8-11, 1999. Second and third place entries will receive certificates, as will first place in the home station with emergency power category.

We hope this event provides satellite operators with the practice necessary to set up a ground station and effectively operate via the satellites in an emergency situation. Remember that Field Day also provides a good opportunity to expose newcomers to the Amateur Radio satellites. Most of all, it should be a lot of fun for all who participate.

GL ON FD ES 73

Andy, W5ACM

Satellite Summary Sheet, AMSAT Field Day
26-27 June 1999

Sheet ___ of ___

Analog Satellite Operation Satellite/Mode	*CW* QSO's	*Phone* QSO's
Multiplier	x3	x1
Analog Subtotals		

Digital Satellite Operation

Satellite	Uploads/Downloads
Multiplier	x3
Digital Subtotal	

Score Calculation

Analog CW Subtotal (above)	
Analog Phone Subtotal (above)	
Digital Subtotal (above)	
Grand Total	

Your Field Day Call Sign:
Your Field Day Group Name:
ARRL Field Day Classification: **ARRL Section:** _____
Power Source: Emergency: **Commerical:** _____
Your Name and Call Sign:
Home Address:
Comments:

Figure 1. AMSAT Field Day Score Sheet -1999

NASA Provides Space Qualification Funding to SAREX/ARISS

NASA has provided a $90,000 boost to the cause of giving Amateur Radio a permanent place in space. The money, recently transferred to the US-based Space Amateur Radio EXperiment (SAREX) team from NASA's Education Office will support the space qualification of Amateur Radio hardware bound for the International Space Station as part of the Amateur Radio on the International Space Station (ARISS) program.

AMSAT-NA's Vice President for Human Spaceflight Programs and ARISS Administrative Chairman Frank Bauer, KA3HDO, says ARISS was *ecstatic* to learn of the subsidy for this crucial facet of the ARISS hardware development. "While this may sound like a great deal of funding to the Amateur Radio community, it represents approximately one-seventh of what we expect will be required to fully develop all three phases of the ARISS hardware system," he said.

The ARISS initial station hardware - basically dualband HTs is currently being prepared for launch in October 1999 on STS-101. More sophisticated transportable ham gear will be delivered in late 2000 or early 2001. The rack-mounted permanent station is expected to be launched in 2003 or 2004. Qualification testing—sometimes called *shake-and-bake testing* is required of all equipment bound for the ISS or for use in human spaceflight. The detailed, rigorous testing sequences are aimed at ensuring crew safety and minimizing equipment failure.

The bulk of the $90,000 will go to support space qualification of the ARISS initial station hardware and some early aspects of the transportable station. Space qualification of the initial station has proven to be a bit of a challenge, in part because of the international nature of the equipment contributions. The US and German-developed radio hardware will be installed inside the pressurized Russian service module, while Italian, Russian, and US-developed antenna systems will be installed on the outside. Mounting the antenna system hardware and the coaxial feedlines will require a space walk, or EVA. "Ensuring the ARISS hardware can pass the EVA safety tests is our most challenging task," Bauer said.

The ARISS team has been working at Goddard Space Flight Center with a NASA contractor team from Orbital Sciences Corporation to deliver the ARISS Safety Data Package and ensure the ARISS hardware is flight-qualified.

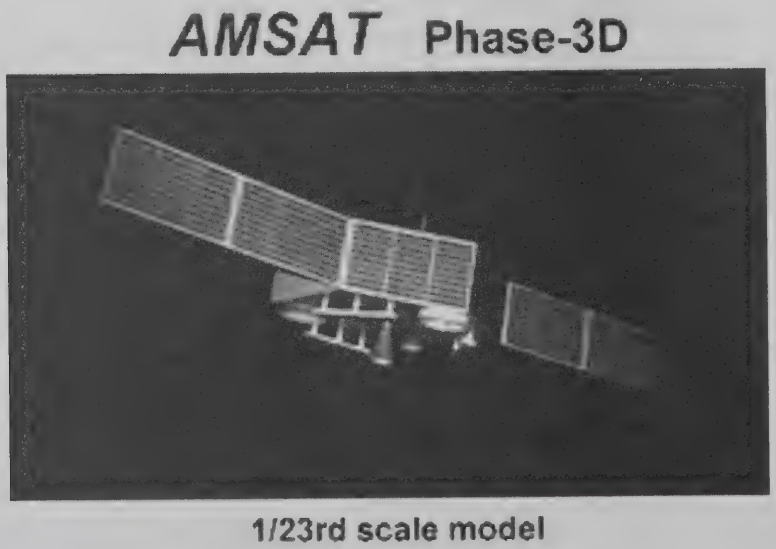


Figure 1. A completed Phase 3D model.

AMSAT Phase 3D Model Available

Through the design efforts of Steve Thompson, K5PK, AMSAT-NA is pleased to announce an offer to support the Phase-3D satellite program via the purchase of a Phase 3D model kit (see Figure 1). With a suggested donation of $17 to the Phase 3D program, AMSAT-NA will provide you, with a full color, glossy card-stock display model kit of the Phase-3D satellite. What better way to commemorate your support of the Phase 3D endeavor? For additional information see: http://www.amsat.org/amsat/fun/model_photos/

AO-27 Satellite Operations are Possible on a Small Budget

John Sheets, N8QGC

I recently went on my first vacation in 18 years. I decided that since I was going to go to the U.S. Virgin Islands, a somewhat sought after contact on AO-27, this would be a fun project.

I went on a Caribbean cruise and originally intended to operate from the deck of the cruise ship. After much conversation and useless attempts at persuasion, I gave up trying to explain what I was trying to do to the ship's radio officer. As per CFR part 97, before you can operate from a ship you must secure permission to do so from the ships master or captain. I figured that the best way to do that was through the ships radio officer, but it didn't pan out.

My first step prior to leaving home was to send out an e-mail message via amsat-bb to inform the satellite community that I was going to be doing this. I received a good response and decided that it would be worthwhile and fun. I received an e-mail from Mal Preston, NP2L, a Virgin Island resident, who provided me with some very useful information. In fact, I'd recommend that anyone wishing to operate from a foreign or strange place try to contact someone who lives there. Mal informed me of a place that would probably be my best shot to access the satellite from since there are high hills/mountains to the North of where the ships dock when they come in. This was crucial to me since I'd be south of those obstructions.

Mal suggested operating from a place called Megens Bay. He said it is located on the north side of the island offering access to AO-27 since you would be on the other side of the hills/mountains. He also offered me some advice on some recreational activities such as good places to snorkel.

When I arrived in St. Thomas, I stepped off the boat, duffle bag in hand, and hailed a taxi. The trip was not long, maybe 15 minutes and soon I was standing in Megens Bay. What a beautiful operating position this turned out to be. I got set up and noticed that I'd forgotten one semi-vital piece of equipment, a compass! I had a rough idea of where to point the antenna thanks to Mal informing me that I was on the north side of the island, but past that I was on my own. I've been doing this awhile so this did not pose a huge problem to me, but to the newcomer this could have prevented the event. Bottom line, pack a compass!

I set up using an Alinco DJ-G5T 2meter/ 70centimeter FM handheld for my radio, PEP of 5 watts. The antenna, a freshly purchased Arrow 2meter/70 centimeter satellite handheld antenna. I donned my headphones, plugged them in to the radio and awaited acquisition of signal. I picked the satellite up much sooner then I expected. Mal had offered me warning that this would be the case. At home in Wyandotte, Michigan, we pick the satellite up about half way into the pass and carry it to loss of signal. Well, in the US Virgin Islands, its the opposite. You pick up the satellite at acquisition of signal and lose it half way into the pass as it shuts itself off to preserve battery power. I made about 10 contacts and had a ball (see Figure 2). This was a nice way to bring a hobby I love on vacation with me.

Many thanks to Mal Preston, NP2L for all his suggestions. He played a huge part in my success. 73 De John N8QGC

AMSAT Annual Meeting and Space Symposium News

Recent and future developments in Amateur Radio satellites will be presented in San Diego, California on October 8-11, 1999 at the 17th Space Symposium and AMSAT-NA annual meeting. The location for this year's event is the beautiful Hanalei Hotel in the heart of San Diego's Mission Valley, a short distance from many of San Diego's attractions. For entertainment you can visit Sea World or the world famous San Diego Zoo. History buffs can "discover" San Diego at Cabrillo National Monument or experience periods of San Diego's history by visiting Mission San Diego de Alcala, Presidio Park, Old Town San Diego State Park and Balboa Park. Golfers will enjoy playing on any of San Diego's many fine golf courses. Of course, there is no shortage of shopping with Mission Valley Center, Fashion Valley Mall, Seaport Village, and Horton Plaza a short ride away. If relaxation is more your style visit scenic La Jolla, Mission Bay Park, Coronado Island or any of San Diego's beautiful beaches.

If you're interested in an Amateur Radio vacation, visit the ARRL Southwestern Division Convention (HAMCON) on the Queen Mary in Long Beach, California October 1-3, then see some of Southern California's sights before attending the 17th Space Symposium and AMSAT-NA annual meeting in San Diego October 8-11. A tentative agenda includes the Space Symposium all day Friday, October 8th and Saturday, October 9th. There will be a satellite session for beginners Friday evening and the annual banquet will be held Saturday evening. An IARU Satellite meeting will be held Sunday morning, October 10th followed by the AMSAT-NA board meeting Sunday afternoon and all day Monday, October 11th. Further details will be available later this year.

For more information on San Diego's facilities and attractions contact the San Diego Convention and Visitor's Bureau at 888-969-9310. Hotel reservations for the Hanalei Hotel in San Diego can be made by calling the hotel at 800-882-0858. Be sure to mention AMSAT to receive the $85 per night discounted group rate. This rate is available for rooms reserved between October 4 and 12, 1999. The local contact for the AMSAT event is Duane Naugle, KO6BT and can be reached at *ko6bt@amsat.org*.

Meanwhile, it was recently announced that the Portland Amateur Wireless Association (PAWA) will host the 18th AMSAT-NA Space Symposium in Portland, Maine in the Fall of 2000. Peter Sturdivant, N1PS, President of PAWA says this event will be exciting for amateur radio in Maine as well as for the surrounding community. In addition, Maine is an ideal vacation destination, especially during the transition from Summer to Fall so large AMSAT participation is anticipated. N1PS will be glad to answer any questions about the 18th Symposium via email at *pfssales@ime.net*.

Seventh Annual AMSAT Jewelry Contest

Dave Guimont, WB6LO welcomes all to San Diego and to the seventh annual AMSAT jewelry contest! San Diego is well known by the military from all of the services both retired and active duty. A lot of us have been through several wars, but most of us are convinced that the pen is mightier than the sword! Hence, the *PEN-tenna*. Think of this as *desk jewelry* (see Figure 3). My wife

Figure 2. John Sheets N8QGC's working AO-27 in the U.S. Virgin Islands.

Leanore, KA6UCD would not let me hang trinkets anywhere else on her! Maybe next year we can get back on track.

No, the pen-tenna does not have five elements. It is a very ordinary *inverted vee* constructed from two stainless and gold plated Parker pens. The pens are removable and usable. At least ten satellite contacts were completed using the antenna suspended about a foot from the ceiling in our wood frame one-story home (to keep it away from most metal masses). A kit pre-amp from HAMTRONICS was used at the antenna. The VSWR at the resonant frequency is 1.1 or less as indicated by a frequency plot, and typical of this configuration it is very broadband. It has been tested at 150 watts RF output.

The elements are 6 15/32" long and nominally 9/32" in diameter. They subtend an angle of 108 degrees. A modified BNC *tee* provides a connection for the elements. Copper and brass tubing forms the pen-holder attachment. A BNC coupler is incorporated for the feedline attachment. A male BNC to female "N" adapter is provided. You don't use PL259's at this frequency do you? The modified BNC is encapsulated in a cast resin base that is about 5" x 6". Various IC's are *floating* in the base along with an AMSAT logo. A telescoping set of elements that will tune from about 600 MHz to 130 MHz is also furnished should you choose to operate it at those frequencies. That exercise is left to the user.

We know that Tom Clark, W3IWI will not be bowled over after his *bowled approach* to another set of frequencies, but neither are we the least bit *pensive* about our accomplishments!

The contest. Your job, should you choose to take the assignment, is to determine the resonant frequency of the antenna. Please present your answer in MHz. The frequency band is obvious, but the exact frequency will determine the winner. It has been determined to two decimal places, but to preclude a tie the winning answer has been estimated to six decimal places.

Leanore will announce the winner at the banquet on Saturday evening. You need not attend the banquet or the convention to enter the contest.

Anyone can enter, you do not have to be a licensed amateur, but please only one entry per person. Modify it at any time, but let us know so we can remove the old entry. Duplicate entries will be discarded. Telephone, snail mail, e-mail, or any frequency you find us on will be ok. If not attending the convention, however, the deadline is the 1st day of October. For those attending the convention the deadline is at 1500 PDT on Saturday, October 9,1999.

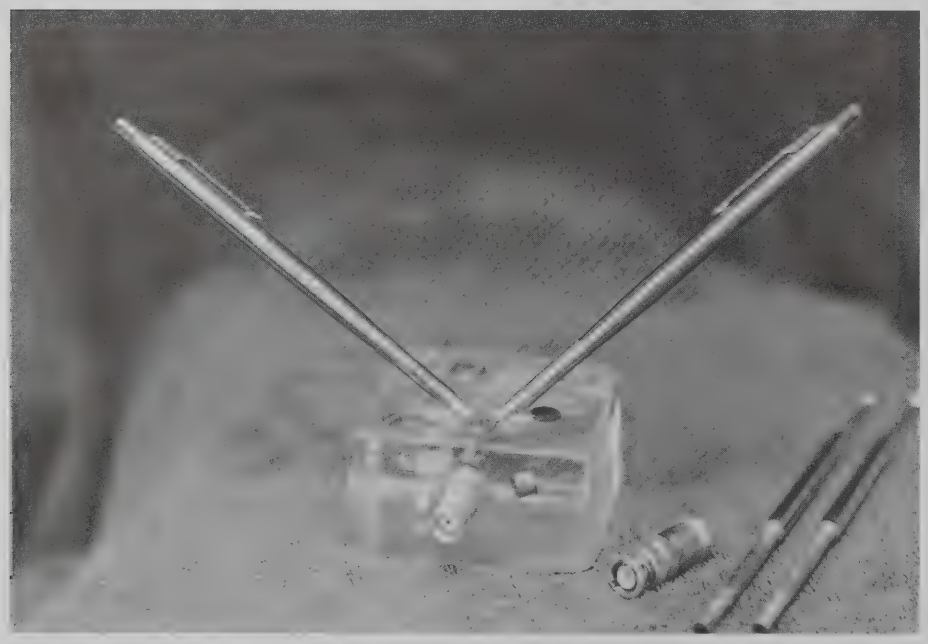


Figure 3. Correctly identify the resonant frequency of the WB5LLO pen-tenna and take it home from San Diego!

Questions and answers to: Dave (wb6llo@amsat.org) or Leanore (*LBGuimont@aol.com)* Guimont, 5030 July Street, San Diego, CA 92110-1112. Telephone: 619-275-1495. This missive and pictures of the antenna can be found at: *http://members.aol.com/dguimont.*

Errata

- Cesar Dagilo, LU8EBH's call sign was mistakenly published as LU8EBF in the articles titled "The Amateur Satellite Service in 1998" and "YV7/W2RS" that were printed in the November/December 1998 issue of *The AMSAT Journal.* We apologize for any inconvenience that this mistake may have caused readers.

- The Houston AMSAT-Net is heard on 0100 UTC on Wednesday (Tuesday 2000 CDT), via GE-1 (W1), T12, 5.7 MHz at 103° and not the Hughes SBS6 as reported in the March/April issue of *The AMSAT Journal.* The net is also available via affiliated repeaters in North America and on Real Audio at *http://www/amsatnet.com.*

FX0STB on *Mir*

AMSAT France President Bernard Pidoux, F6BVP recently provided advice on making QSOs with French astronaut Jean-Pierre Haigneré who is spending six months on board *Mir* space station. The purpose of Amateur Radio for him is to maintain contact with Earth dwellers. With *Mir* at an altitude of more than 300 km, many ham stations can contact him at the same time, especially while over densely population areas such as the United States and Europe. The peculiarity of VHF and UHF satellite links is that most ground stations don't hear each other. However, at the same time *Mir* receives all the stations within its footprint If several stations transmit at the same time on the same FM frequency, *Mir* receives garbled noise.

To make contacts easier with FX0STB, it is suggested to adopt some simple rules, thus allowing everyone a chance to talk with FX0STB. The first rule is to *listen* to the 145.985 MHz FM frequency. When *Mir* is transmitting fixed SSTV pictures or packet radio messages it usually means that the astronaut is not playing with ham radio. The second rule is *not* to call *Mir* if FX0STB is not calling CQ. The third rule is to *not* intervene

during a contact that is already in progress. That is, do not call FX0STB before he asks QRZ.

To give everybody a fair chance to contact *Mir*, the last recommendation is to *not* call FX0STB systematically during each pass. Instead, use the following steps for QSO:

1) QRZ from FX0STB on board MIR ?

2) Each ground station calls using the last characters of their call sign. For example, lets say that F8IU is calling. He will say, "India Uniform, India Uniform."

3) Jean-Pierre calls, "India Uniform from FX0STB."

4) The station that is called answers, "FX0STB from Foxtrot 8 India Uniform. You are 5 and 9. Many thanks. QSL?"

5) Jean-Pierre answers, "Foxtrot 8 India Uniform. You are 5 and 9. Thanks for the contact. QRZ from FX0STB?"

6) Go back to step 2.

If Jean-Pierre wishes, a contact with a particular station can last longer. In that case, the other stations are asked to remain silent and not to call during these exchanges.

Satellite Orbital Elements

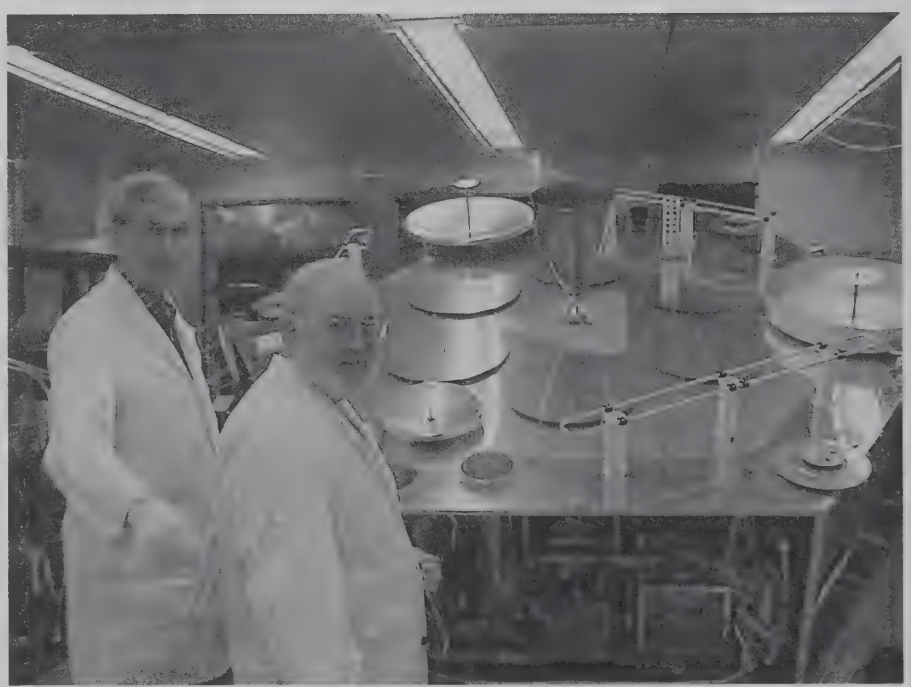
by Ray Hoad, WA5QGD

Satellite	AO-10	FO-20	RS-12/13	AO-27	RS-15	FO-29	UO-11	AO-16
Catalog Number	14129	20480	21089	22825	23439	24278	14781	20439
Epoch Time	99135.74474177	99140.11236447	99140.01726670	99140.17955635	99139.90386210	99139.88106655	99139.89231882	99140.15532745
Element Set	571	154	159	751	393	260	156	245
Inclination	27.0857	99.0263	82.9207	98.4586	64.815	98.5601	97.927	98.4833
RA of Node	29.3455	340.1764	118.1456	205.7039	98.1409	94.8151	107.0944	219.2212
Eccentricity	0.6019298	0.0539784	0.0029761	0.0008731	0.0157009	0.0351579	0.0010508	0.0010977
Arg of Perigee	314.5727	228.2288	140.2686	348.7549	357.9678	167.3507	285.1714	306.1511
Mean Anomaly	10.0485	127.1474	220.0656	11.344	2.0588	193.6743	74.8314	53.8657
Mean Motion	2.05872702	12.83253208	13.74132388	14.27888313	11.27533806	13.52667131	14.70424959	14.30194487
Decay Rate	-0.00000392	0.0000009	0.00000106	0.00000152	-0.00000041	-0.00000055	0.00001291	0.00000243
Epoch Rev	11972	43473	41554	29424	18105	13598	81433	48656
Satellite	DO-17	WO-18	LO-19	UO-22	KO-23	KO-25	IO-26	TO-31
Catalog Number	20440	20441	20442	21575	22077	22828	22826	25396
Epoch Time	99140.27895413	99140.15587125	99140.27363165	99140.10523768	99140.28937549	99140.16368965	99140.16223625	99140.21145840
Element Set	231	262	236	973	831	723	729	159
Inclination	98.4882	98.4898	98.4948	98.2015	66.0799	98.4586	98.4626	98.762
RA of Node	220.8205	220.4916	221.764	181.9269	115.1565	206.2808	206.1503	213.9278
Eccentricity	0.0010981	0.0011463	0.0012055	0.0007427	0.0013099	0.0010018	0.0009805	0.0005821
Arg of Perigee	304.9732	304.9751	303.9534	313.307	229.7649	329.428	347.63	134.7334
Mean Anomaly	55.0401	55.0356	56.0501	46.7483	130.2224	30.6315	12.4633	225.4325
Mean Motion	14.30349585	14.30299457	14.30427647	14.3731055	12.86322619	14.28376521	14.28010401	14.22366057
Decay Rate	0.00000195	0.00000227	0.00000234	0.00000323	-0.00000037	0.00000224	0.00000217	-0.00000044
Epoch Rev	48662	48660	48665	41130	31805	26241	29426	4464
Satellite	GO-32	SO-33	PO-34	SO-35	UO-36	MIR	ISS	Phase 3D (est)
Catalog Number	25397	25509	25520	25636	25693	16609	25544	99934
Epoch Time	99140.16277274	99139.81168147	99139.75020545	99140.87295677	99140.25456	99140.18794	99140.72284	96260.25523447
Element Set	201	61	85	45	19	512	595	3
Inclination	98.7552	31.4451	28.4627	96.4829	64.5548	51.662	51.5943	60.0203
RA of Node	213.7983	311.3357	275.1675	75.0199	230.0521	127.2812	336.1446	342.7876
Eccentricity	0.0001431	0.0368997	0.0006692	0.0153566	0.0003862	0.0007072	0.0003975	0.6752895
Arg of Perigee	115.3292	249.2327	5.7676	341.5581	356.2143	123.5296	138.0705	180.1221
Mean Anomaly	244.8036	106.839	354.2996	18.0094	3.8929	236.6378	222.1234	179.5089
Mean Motion	14.22241416	14.23964797	15.03598282	14.40850249	14.73177333	15.71316669	15.61317017	1.51063968
Decay Rate	-0.00000044	0.00000339	0.00001766	0.00000565	0.00000456	0.00010198	0.00021263	0.00002
Epoch Rev	4465	2956	3042	1244	426	75700	2891	2

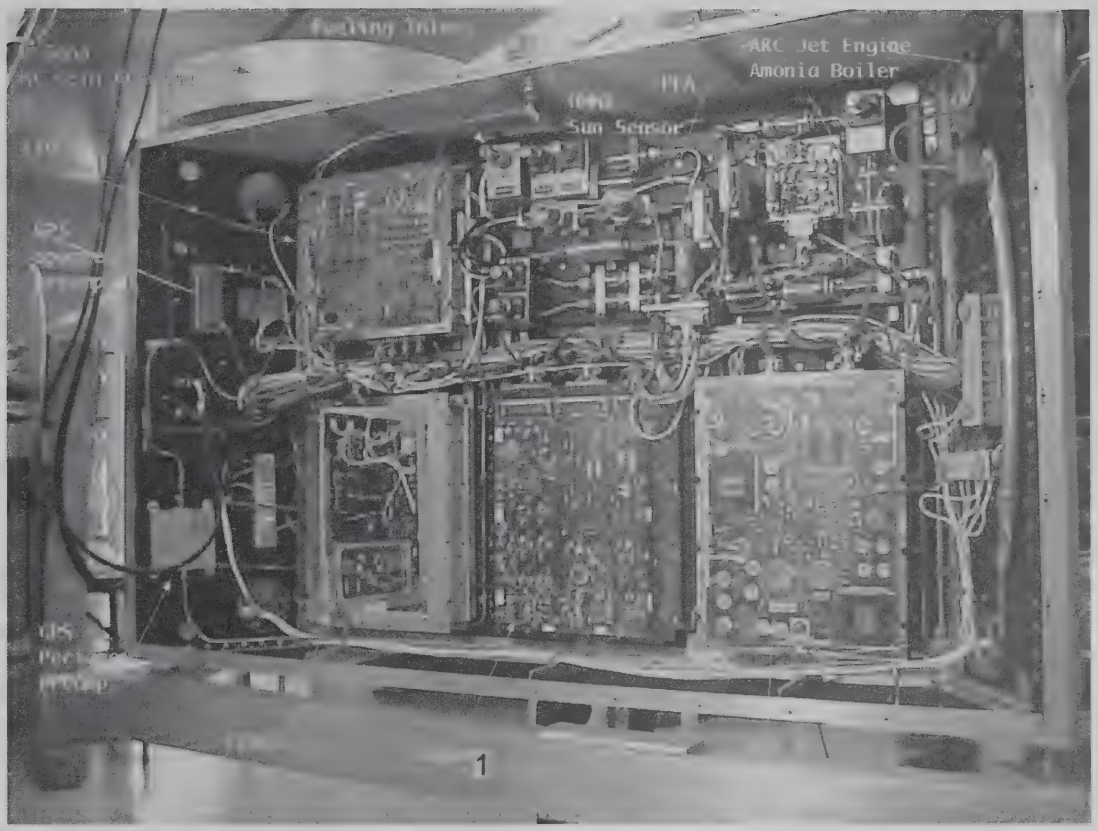
Phase 3D Update

Phase 3D Team (left-right) Back row: Matjaz Vidmar S53MV, Wilfried Gladisch, Horst Wagner DB2ZB, Lyle Johnson WA7GXD, Peter Gülzow DB2OS, Chuck Green N0ADI, Harold Price NK6K, Bob Davis KF4KSS Michael Fletscher OH2AUE. Front row: Mirek Kasal OK2AQK, Werner Haas DJ5KQ, Rick Leon KA1RHL, Freddy de Guchteneire ON6UG, Karl Meinzer DJ4ZC.

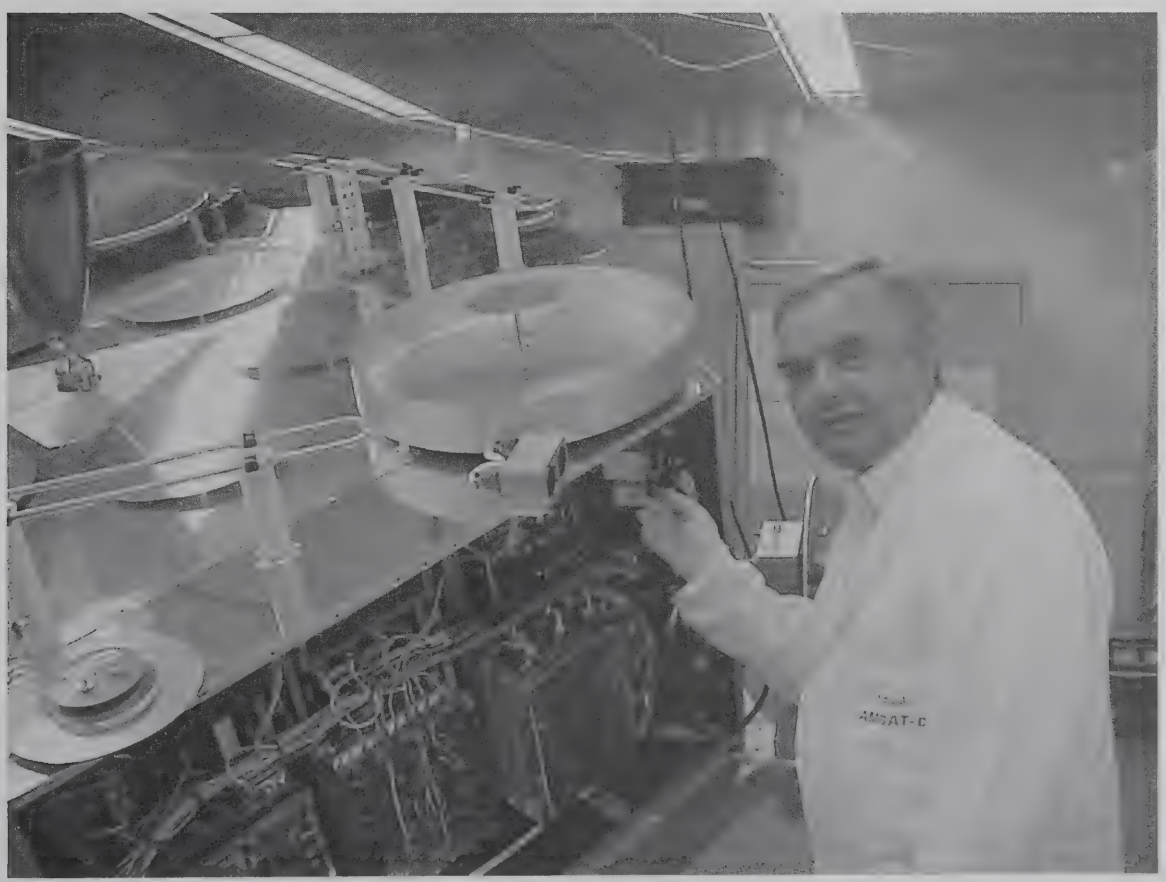
A large group of Phase 3D engineers from AMSAT-DL (including European team members from Belgium, Czech Republic, Finland, and Slovenia) and AMSAT-NA were at the Phase 3D Integration Laboratory in Orlando, Florida from March 3-26, 1999. The team finalized the Phase 3D spacecraft after the successful thermal vacuum testing at Orbital Sciences Corporation in Maryland (see "Phase 3D Thermal Vacuum Tests at Orbital Sciences Corporation," *The AMSAT Journal*, Nov/Dec 1998). All Phase 3D electronics were completely tested again and where necessary, corrections were made. Most of the module electronics were foamed or covered with conformal coating in preparation for the final vibration/shake tests. Another final check-out of all electronics will be conducted when the spacecraft returns from the vibration test. After this we are ready for launch. ■



Stan Wood, WA4NFY (l) and Lou McFadin, W5DID (r) displaying the Phase 3D antenna suite.



Bay 1 on Phase 3D with labels courtesy of Lou McFadin, W5DID.



Mirek Kasul, OK2AQK performing antenna adjustments.

Mir-Day at Seminary Hill School

Bill Burden, WB1BRE

In 1998, I forwarded a bulletin to the TSRC (Twin State Radio Club in the Lebanon, NH and White River Jct, VT area) from the *Mir* team here proposing a project to contact the *Mir* space station via packet radio. The plan was to ask all other users to stand down for the day of the experiment and to allow stations operating out of classrooms to both monitor *Mir's* packet output and to transmit station and class information to MIR.

I got a message from James Dean, N0JSR, indicating that his son's fifth grade class at Seminary Hill School in West Lebanon, New Hampshire would like to participate in the project. James and I worked out the details with the class teacher, Marian Waters, including installation of the antenna on the roof of the school.

The project was on Monday, April 27, 1998 so we met with Marion on Sunday, the 26th to install the station. James and his son installed a 2 meter antenna on the roof by taking all the components, including the tripod, up via a ladder and through a trap door on the roof! The coax was payed out over the roof edge and in through a window in the classroom.

We set up Verne Burden's, N5IEP portable packet station using a small laptop which also had the AMSAT InstantTrack software. This software tracks the *Mir* space station and displays its position on a colored map of the world. We were able to hear *Mir* on one pass on Sunday afternoon.

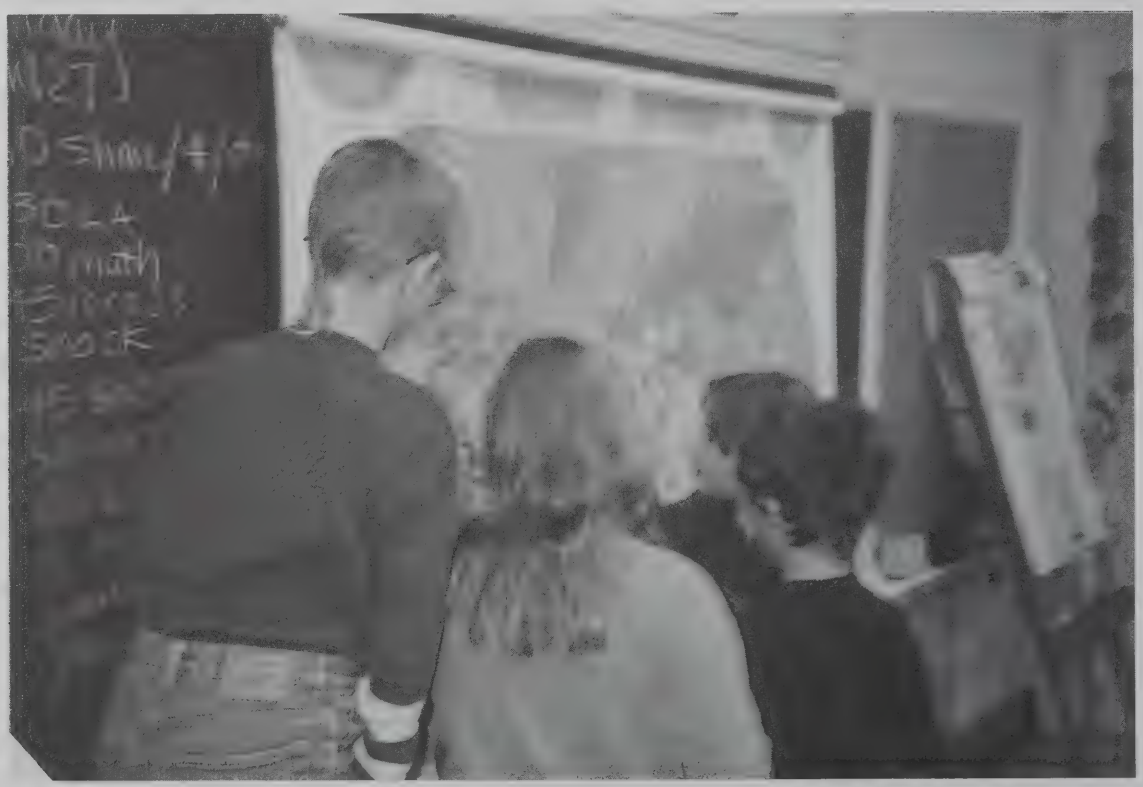
Because experiments involving Amateur Radio on *Mir* have been plagued with various problems, including equipment problems and little inconveniences like collisions with docking spacecraft, we decided early in the planning to develop a complete learning experience involving Internet web sites, tracking of the space station, applying latitude and longitude to the tracking effort, and model building.

On Monday, we arrived mid-morning, met the class and set up the packet station. Marion had designated Monday as *Mir Day* for the 5th grade with posters and pictures. Actually we had two classes with about 30 students total. One group was in the computer lab, studying *Mir* on various web sites and getting basic information about the vehicle. The other class was in the classroom, where we did a short viewgraph presentation on *Mir* and the project.

Later, while we waited for the first pass of the morning, the teacher had teams of 3-4 students go to the tracking map on the PC and find *Mir's* latitude and longitude. They then located this position on a large world map on one wall of the classroom and marked the spot with an erasable marker. They also put their initials on each location. This was continued at 10-minute intervals and the students developed the *Mir* track on a large wall map of the world.

The tracking program was one of the more fascinating parts of the project for the students. Each team of students studied the position of *Mir*, ran over to the wall map and generally had vigorous discussions about the location before actually plotting the point. Their teacher told me that they had had been lectured on latitude and longitude, but this was the first time they had actually used the knowledge to develop something useful! By the end of the day, every student was highly skilled at using lat/lon for *navigation*!

As the track developed, a big question arose—- would the second pass of *Mir* repeat the track of the first pass, or would it be different? Once we started plotting the



The *Plotting Team* determining the location of *Mir* using a classroom map. (photo by Bill Burden, WB1BRE)

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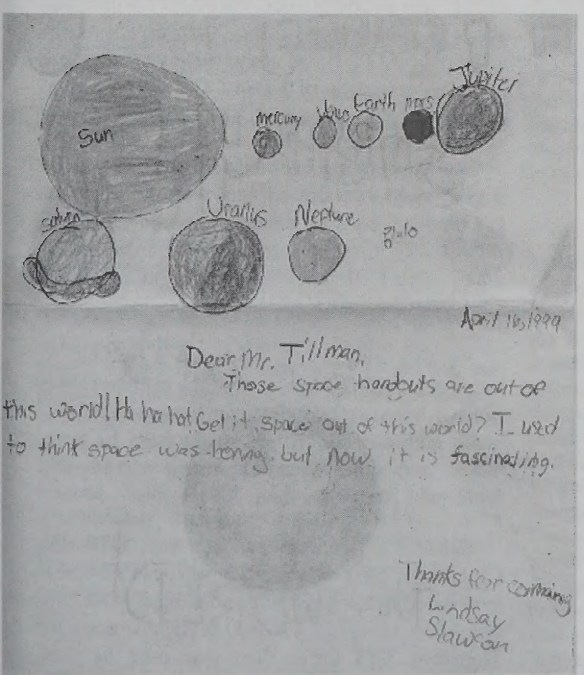
second pass, it became clear that the track was further west. This led to a big discussion on why this was so. One student did figure out that the Earth was moving under the space station, so a little more learning occurred.

Finally, as a climax to the day, we passed out cardboard cutout models of the Phase 3D and Microsat satellites to each student. Many worked through their lunch hour with scissors and glue to build their spacecraft and we soon had a room full of satellites in *Low Earth Orbit*!

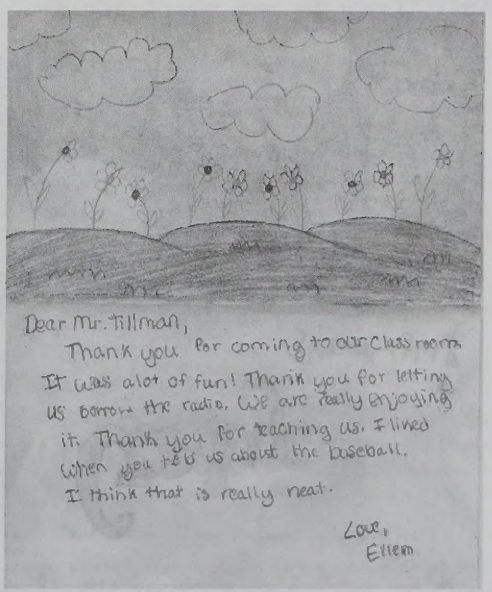
It was an exciting and worthwhile experience for both the students and for James and me, even without an actual *Mir* contact. The kids asked great (tough) questions and it really was a challenge to present material to a class of very inquisitive 5th graders!

Oh, how about contacting the *Mir* space station? Well, as it turned out, we had some frequency problems and *Mir* did have an equipment failure so they were not on the air for the scheduled project period. They did get back on frequency the next day, but most school stations, including ours, were not operating.

As a follow-up, the MIREX team is planning to schedule a rerun of the school day experiment in the near future. We have confirmed with Marian that she would be interested in trying for a contact again, so we expect to hit the classroom soon! ■



As a sidebar to this article, your Journal Editor was recently invited to give a talk on *Space* to his daughter's 4th grade class at St. Francis School in Vicksburg, MS. The talk focused on a simple explanation on how things get into orbit and facts and figures about the *Mir* and International Space Station (ISS). Students were also provided with information on how and when to observe visual *Mir* and ISS passes. In addition, a scanner was left in the classroom to monitor *Mir* communications. Despite the simple set up, students are surprised and fascinated when they heard packet transmissions that came on during the course of the school day; certainly a welcomed educational relief from the 3Rs! Meanwhile your editor was much surprised and fascinated to receive over 45 thank you notes from the students!


Dear Mr. Tillman,
Thank you for coming to our Class room. It was a lot of fun! Thank you for letting us borrow the radio. We are really enjoying it. Thank you for teaching us. I liked when you tells us about the baseball. I think that is really neat.
Love,
Ellen

APRS via Outer Space Using AO-27

Farrell Winder, W8ZCF and Jeff Winder, KB8VCO

Photo 1. KB8VCO's mobile APRS set up.

As a follow up to a previous Automatic Positioning Reporting Experiment (APRS) satellite test between Mel Lehman, KW7E and Farrell Winder, W8ZCF, it was envisoned that there was a possibility that long range tracking of a *moving* vehicle could be accomplished using APRS and a satellite.

My son, Jeff Winder, KB8VCO and his family took a vacation trip from Cincinnati, Ohio to Juarez, Mexico. Their trip allowed us to continue and expand the KW7E/W8ZCF experiment, Jeff equipped his station wagon with a roof-mounted Comet SB7 dual band vertical (2m/70cm) antenna,and a Garmin GPS45XL receiver that was fed into a KPC-9612 TNC that was combined with a laptop computer (photo 1). A Yaesu FT-530 provided about 5 watts output to AO-27's 145.850 MHz uplink. This set up provided very successful and exciting results.

One of the AO-27 passes was scheduled by KB8VCO each day with W8ZCF, who was standing by to receive an APRS position report. Photo 2 shows a composite of some of the positions that were recorded during KB8VCO's trip to and from Mexico. When the APRS signal is received by an equipped station, the call sign of the transmitting station along with a symbol appears on a map generated on the receiving station's computer screen. In this case, the symbol is KB8VCO's station wagon. The photo also shows W8ZCF's QTH with a house symbol and Yagi antenna. The first recorded APRS transmission of KB8VCO after departing Cincinnati was one close to the Natchez Trace State Park, Tennessee off I-40. The second and third KB8VCO APRS transmission reports were recorded by Mel Lehman, KW7E in Arizona as Jeff proceeded thru Waco and Belton, Texas.

Ground Speed Measurements via AO-27

The next position which was recorded near Junction, Texas was particularly interesting. The following two successive transmissions were recorded when Jeff was transmitting APRS transmissions about 10 seconds apart:

- 211843z3031.24N/09945.95W
- 211843z3031.22N/09946.11W

The longitude and latitude difference between these successive transmissions recorded and the distance between these two points were calculated to be 0.159 statue miles. As a result, Jeff's speed was approximately 58 mph. This was calculated by constructing a right triangle using the differences in latitude and longitude. One side of this triangle is 0.02° and the other side is 0.16° and the total distance is then calculated to be 0.161245°.

If 1° equals 6080 feet at the equator, then at N30.52°, then:

- 6080 ft. x. cos 30.52 x 0.161245 = 845 ft.

If 845 feet were traveled in 10 seconds, then:

- (845ft/10 sec) x (mile/5280 ft) x (3600 sec/hr) = 57.6 mph.

Photo 2 also shows a position in Juarez, Mexico and a position on I-44 between Oklahoma City and Tulsa, Oklahoma on the return trip. KB8VCO's position reports were usually accompanied by a 4 or 5 word message which followed the latitude and longitude data.

This continuing experiment turned out to be just as exciting and a lot of fun as was the initial experiment with the fixed location of KW7E in Phoenix, Arizona. This experiment not only provided the exact whereabouts of Jeff's family to his parents in Cincinnati, Ohio, but also the real time speed of their vehicle on the highway. All of this was accomplished via AO-27 which has about ½ watt output on the 70cm downlink. In addition, AO-27 is very receive sensitive allowing reception of KB8VCO's uplink signal during mobile operations.

While tracking vehicles using APRS is becoming more commonplace with the advent of HT transceivers such as the Kenwood TH-D7A, it is usually limited to ex-post facto information when using VHF and UHF APRS frequencies to span long distances.

As this experiment involved a vehicle in motion, an AO-27 two-way voice exchange was not attempted at the same time. However, AO-27 voice communication was made from El Paso, Texas and other locations using a traditonal hand-held Arrow antenna.

W8ZCF's equipment at his QTH in Cincinnati, Ohio consisted of a Yaesu FT-736R multiband transceiver with a Rutland FO-22 for receiving AO-27 on 436.800 MHz (corrected for Doppler). STS Orbit Plus was used by both stations to track AO-27. ■

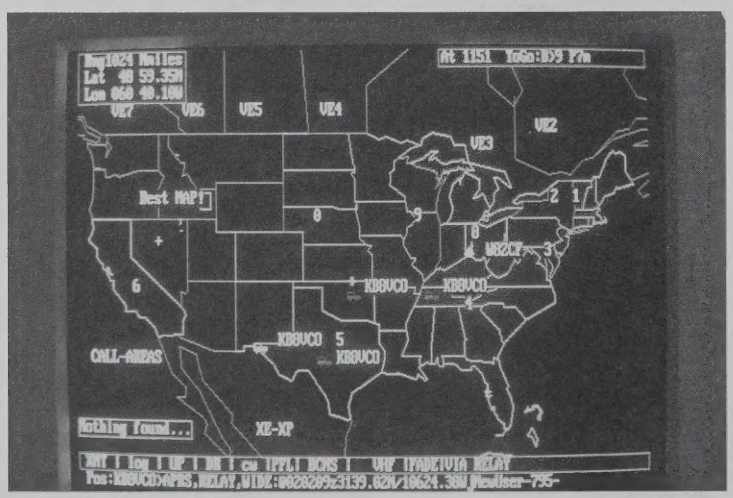


Photo 2. U.S. map showing KB8VCO's APRS reports during their Cincinnati to Juarez, Mexico trip.

Minutes of the AMSAT Board of Directors Meeting Held March 13, 1999 in Maryland

The meeting was convened by Chairman of the Board Tynan at 4:30 PM on Saturday, March 13, 1999 at the Goddard Space Flight Center in Greenbelt MD. Members of the Board of Directors (BoD) in attendance were:

- Keith Baker, KB1SF - President
- Tom Clark, W3IWI - President Emeritus
- Dick Daniels, W4PUJ
- Andy MacAllister, W5ACM - VP User Services (by telephone)
- Bill Tynan, W3XO - Chairman of the Board

Others participating included:

- Barry Baines, WD4ASW - Alternate Board Member and VP Field Operations
- Jan King, W3GEY
- Martha Saragovitz, Corporate Secretary

Attempts to establish a conference with both Stan Wood WA4NFY and Andy MacAllister W5ACM failed because of technical phone problems. However, in an off-line conversation, Clark did get Wood's views regarding raising the Phase 3D spending cap. Joe Holman, AD7D could not be located.

Year 2000 Annual Meeting Site

Baker began with a proposal that the year 2000 Annual Meeting and Space Symposium be held in Portland Maine. Citing the willingness of George Caswell W1ME and his New England group to coordinate the meeting, the excellent hotel facilities available and the abundance of direct airline flights available; he recommended that the meeting be held at that location. He indicated that a decision and commitments must be made soon because the meeting time coincides with a peak tourist season.

Daniels made the motion to hold the meeting in Portland, Clark seconded and the motion passed by unanimous vote.

Meeting with Paul Rinaldo

Baker reported on a meeting held the previous day with ARRL Washington representative, Paul Rinaldo W4RI. He stated that he, Perry Klein and Bill Tynan had also taken part in that meeting. He said that one of the principal items discussed was a proposal to establish purity of emission standards for all satellites, including amateur satellites. It has apparently been concluded by ITU that such standards are necessary to protect radio astronomy activities as well as other radio services. As it stands at present, the proposed standards would require that transmitters operating in the amateur space service attenuate out-of-band emissions to 43 + 10 log (P) or 60db, whichever is less stringent. Daniels noted that out-of-band emissions, in this context, are defined as those outside of the normal band which the satellite should occupy in accordance with its function, not merely to emissions outside of the amateur satellite service allocations. The options open to AMSAT were stated as, either take no action, whereupon the limits will automatically take effect after WRC 2000, or to respond with reasons for adopting alternative specifications. It was noted that the ARRL can be expected to help in preparing an AMSAT response. King also offered his assistance. It was noted that this question has both international and national (U.S.) aspects. The original letter seeking comment was signed by IARU Satellite Advisor Hans van de Groenendaal. Tynan explained that Rinaldo's involvement is associated with preparation of the U.S. position for the next WRC. As such, he emphasized the need to protect information, which may become part of the formulation of that position, from being made available to those who are not U.S. citizens.

Daniels noted that Perry Klein, Ray Soifer and he have been considering this subject for some time and welcomed the assistance of Jan King in the preparation of an AMSAT position. It was also noted that Karl Meinzer's opinion should be solicited, with proper adherence to the above comment regarding protection of information which may become part of a U.S. WRC position.

Proposed Change to AMSAT Bylaws

Saragovitz noted that she was not sure that our current Bylaws specifically state that AMSAT-NA membership is required of Board members. Clark stated his belief that a clause should be added to more clearly present requirements for candidates to serve on the Board, including that the person must be an AMSAT-NA member in good standing in order to be elected and that he or she should remain so throughout his or her term of office. It was noted that the provision for amending the Bylaws calls for an affirmative vote by two-thirds of the Board and notification of the members of the proposed change. Following such notification, a 30 day period is afforded for members to object. If, during that time, fewer than ten percent of the members object to the change, it becomes effective. It was noted that it had previously been determined that publication of such proposed Bylaws changes in *The AMSAT Journal* constitutes appropriate notification. Clark suggested that Soifer be asked to look into the matter and, if necessary, draft appropriate language. His draft can then be voted upon at the next Board meeting.

It was also suggested that clarification may be needed to define what action, if any, should be taken if a Board member is absent from two successive Board meetings for reasons other than illness or family emergencies. After discussion, it was concluded that the a change to the Bylaws addressing meeting attendance is not needed at the present time

[Following the meeting, at the Board's request, Soifer researched the issue and reported that no change to the bylaws is necessary because Article II, Section 2 and Article III, Section 2 of the Bylaws already require Directors to be members, as does Article Sixth of the Articles of Incorporation. Soifer also reported that Article II, Section 1 of the Bylaws provides that membership shall automatically cease when dues are unpaid, so any Director in that situation thereby ceases to be one.]

Educational Satellites

Tynan stated that Rinaldo, at the meeting held the day before, disclosed that the ITU has a Bureau of Telecommunications Development which has funds to use for educational purposes. Therefore, it might be possible to obtain financial support from this organization for the construction of simple satellites by university groups in less-developed countries. Daniels asked what commitment AMSAT-NA would make in order to take advantage of this? Tynan saw our help as limited to mentoring and providing already existing design information such as the Microsat package. He reminded those present that the Board had previously placed the Microsat documentation in the hands of Bob Twiggs of Stanford University for dissemination to appropriate groups in this country and abroad. He added that AMSAT continues to work with Twiggs in determining whether a particular group requesting the documentation is proposing a spacecraft which meets the Guidelines for Amateur Radio Satellites established by AMSAT several years ago.

Saragovitz announced that Frank Bauer had asked that it be made known that he is currently working with Perdue University regarding the construction of a satellite.

Baker mentioned a note received from Will Marchant regarding a small satellite project named CHIPS that is to gather astronomical data. He said that AMSAT may be asked to help in some manner. King opined that there are numerous spacecraft projects currently underway, and/or proposed, which plan to use amateur frequencies. He believes that many of them do not meet the Guidelines and mentioned several currently orbiting satellites as examples. He also expressed concern for the large number of very small spacecraft being proposed in terms of the space navigation hazard they could present. He said that he had cited these concerns at the 1998 Small Satellite Conference held last August in Logan, Utah. Furthermore, he said, 9 out of 10 projects presented at that conference were expecting to use Amateur Radio frequencies, but that not one of these projects had a single ham listed as a participant. He said that every day the situation gets worse. Tynan reiterated that whenever the has been approached by those wanting to build satellites in connection with a university project that might consider using amateur frequencies, he has always referred them to the Guidelines which are posted on the AMSAT web site. He urged again, as he did at last October's Board meeting, that reference on the site to these Guidelines be made more prominent. Baker said that he would approach Paul Williamson again on this subject and ask that he insert a prominent category titled something like "Thinking About Building an Amateur Satellite?", under which these Guidelines would appear.

Tynan emphasized that the University of Toronto's MOST astronomy project, to which AMSAT is providing assistance, is not proposing to use Amateur frequencies. He also stated that he had proposed at the International Amateur Satellite Symposium held at Surrey last July that, either the AMSAT group or the IARU society in the country where the satellite is licensed should make the determination as to whether or not it qualifies as an Amateur Satellite.

King asked if the suggestion was adopted. Tynan replied that it had not been, but that he believes his suggesting it constituted a first step in establishing such a policy.

It was generally agreed that more discussion and education is needed in this area, both in this country and worldwide. As a step in that direction, King suggested that AMSAT sponsor a conference to get everybody together and explain what the rules are. King emphasized that many of the builders of these spacecraft don't understand what restrictions apply to the Amateur Radio spectrum that they're planning to use. It was agreed that this is a good idea and Baker said that he would begin work on holding such a meeting, possibly in connection with the 1999 AMSAT annual Meeting and Space Symposium.

Closed Session

At this point King departed and the meeting continued in closed session to discuss additional funding for Phase 3D. Among the results of this session was a decision to increase the previously established spending cap by an additional $100,000.

The meeting concluded at approximately 1800 hrs. local. ■

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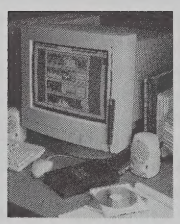

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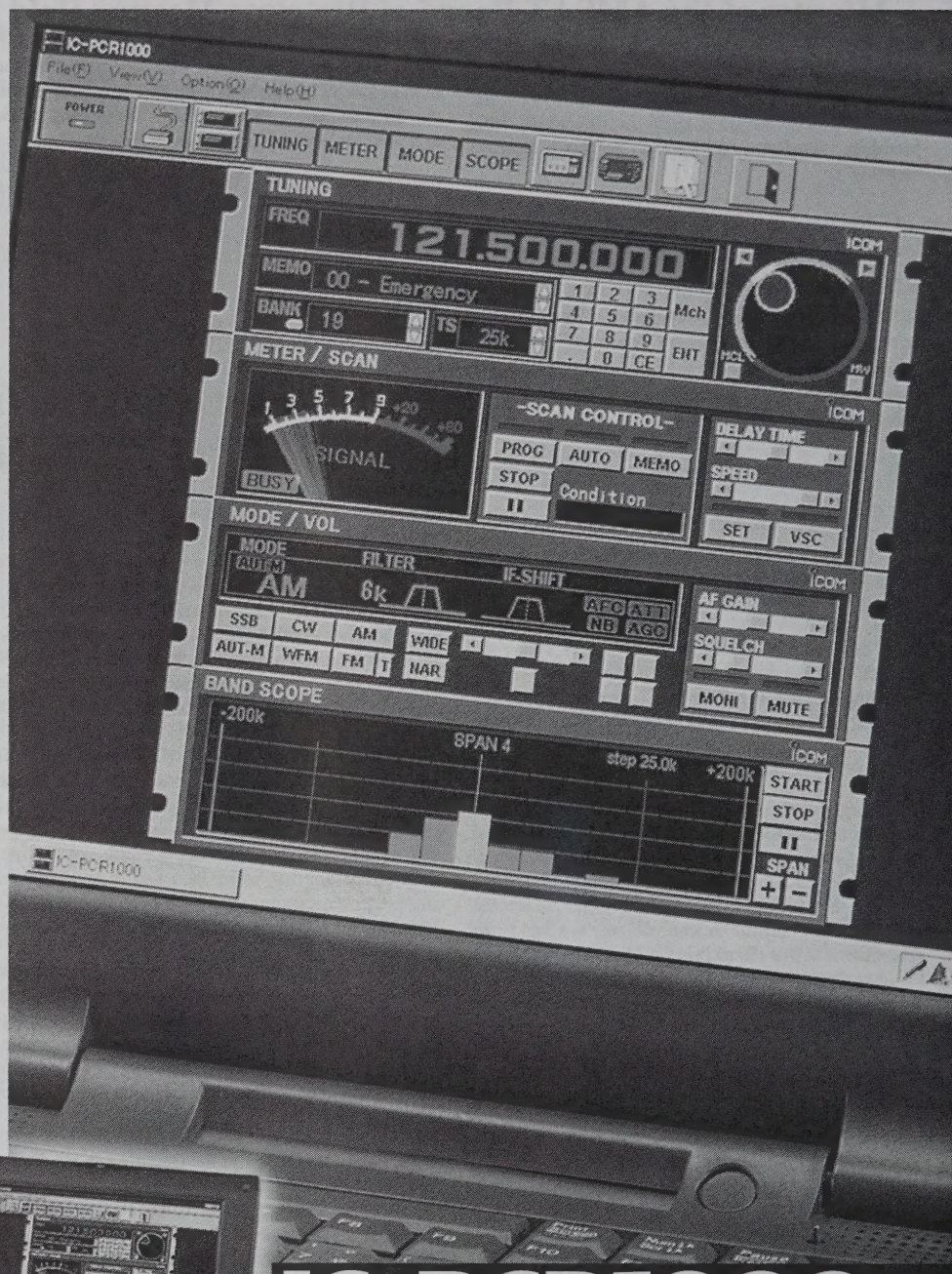

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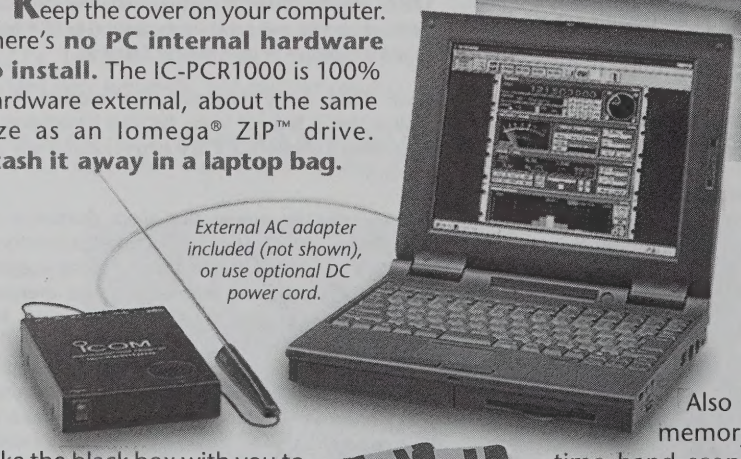

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